Blue-Cloud – Exploring and demonstrating the potential of Open Science for ocean sustainability

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Blue-Cloud Open Conference

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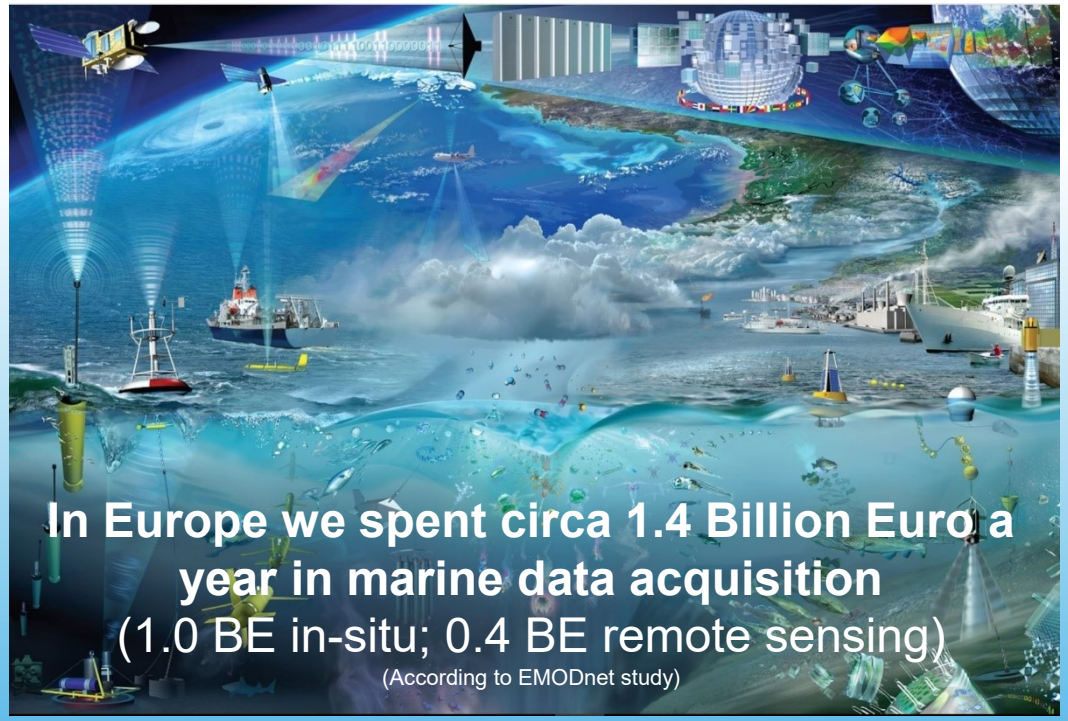
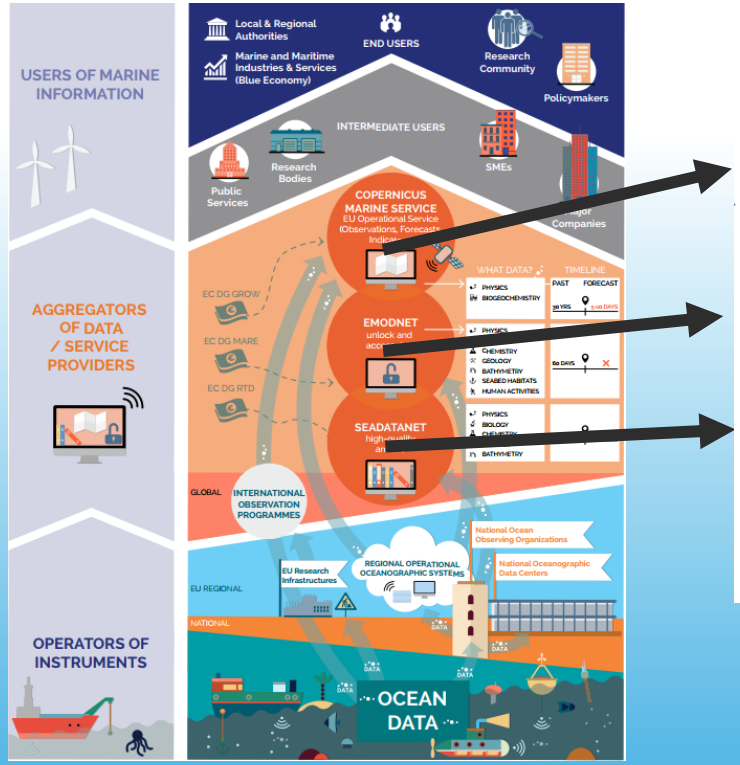
Acquisition of marine and ocean data



- Scientific Research to gain knowledge and insight
- Modelling (including hindcast, nowcast, forecast)
- Economic activities: shipping, offshore industry, dredging industry, fisheries, tourism, engineering ..
- Environmental Management: monitoring and assessment (water quality, climate status, stock assessment)
- Marine Conventions and Directives, in Europe: Water Framework Directive (WFD), Marine Strategy (MSFD), Marine Spatial Planning (MSP), Coastal Zone Management
- EU Strategies, such as Green Deal, Blue Environment, Blue Economy

European landscape marine data management



EuroGOOS European Global Ocean Observing System

EurOBIS European Ocean Biogeographic Information System

Copernicus Marine Service

ICOS Ocean Thematic Centre

emso ERIC

EMODnet European Marine Observation and Data Network

elixir

ICES CIEM

PANGAEA.

SeaDataNet

Euro Argo

ENA European Nucleotide Archive

EGDI

Data aggregators and providers of data products and services

EU H2020 Blue-Cloud project

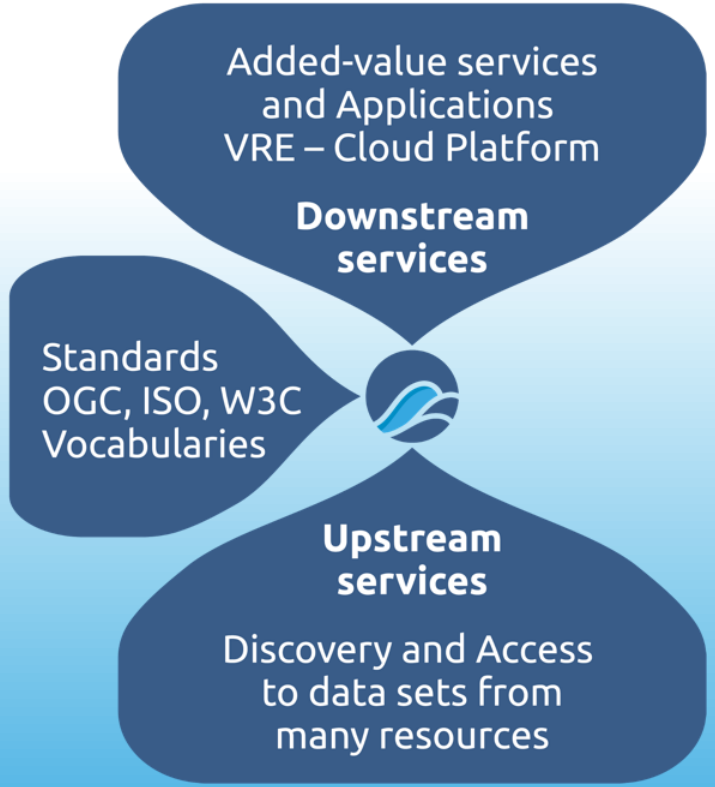
- To explore and demonstrate the potential of **cloud based open science** supporting research for ocean sustainability, and UN Decade of the Oceans and G7 Future of the Oceans
- To deploy a **cyber platform with smart federation** of multidisciplinary data repositories, analytical tools, and computing facilities
- To develop a **marine thematic European Open Science Cloud (EOSC)** serving the blue economy, marine environment & marine knowledge agendas

Blue-Cloud overarching concept

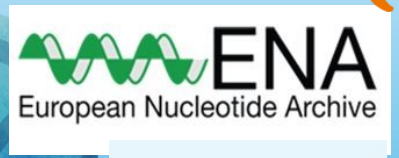
- Developing and deploying Virtual Research Environment (VRE) with an array of services for configuring and running Virtual Labs for specific analytical workflows, use cases, and demonstrators

- Applying common standards and interoperability solutions for providing harmonized metadata and data

- Developing and deploying harmonized discovery and access to established European marine data management and processing infrastructures



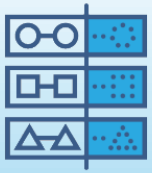
Blue-Cloud federation of major infrastructures

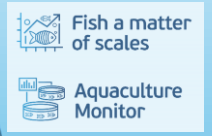


Blue Data infrastructures

E-infrastructures

Key products and services



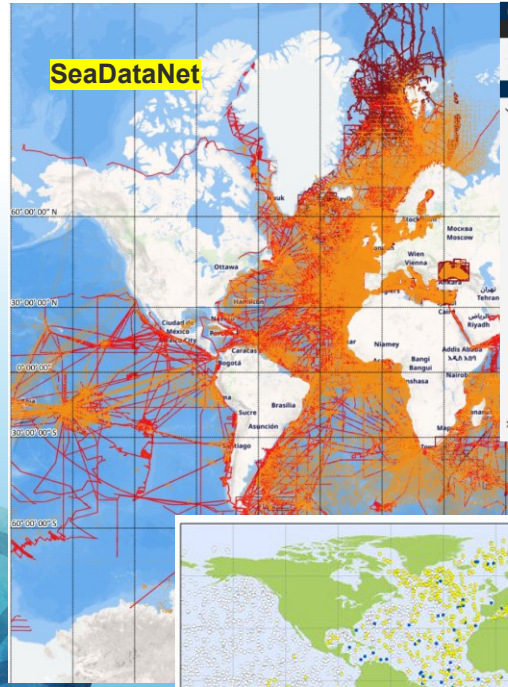


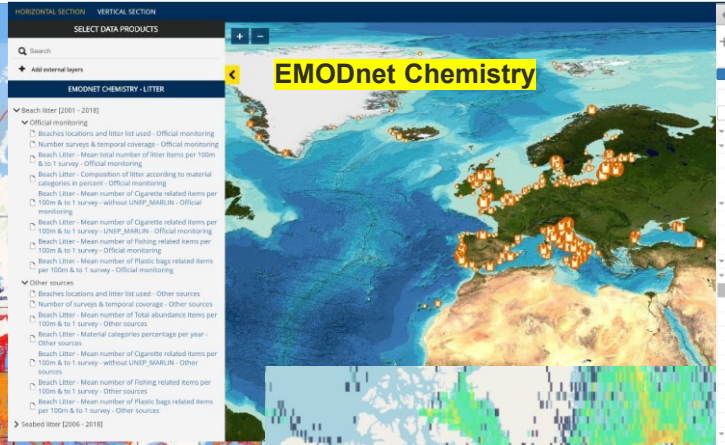
- **Blue-Cloud Data Discovery & Access service**, federating key European data management infrastructures, to facilitate users in finding and retrieving multi-disciplinary datasets from multiple repositories
- **Blue-Cloud Virtual Research Environment infrastructure** to provide a range of services and to facilitate orchestration of computing and analytical services for constructing, hosting and operating Virtual Labs for specific applications
- **Blue-Cloud Virtual Labs**, configured with specific analytical workflows to serve as **Demonstrators,** which can be adopted and adapted for other inputs and analyses

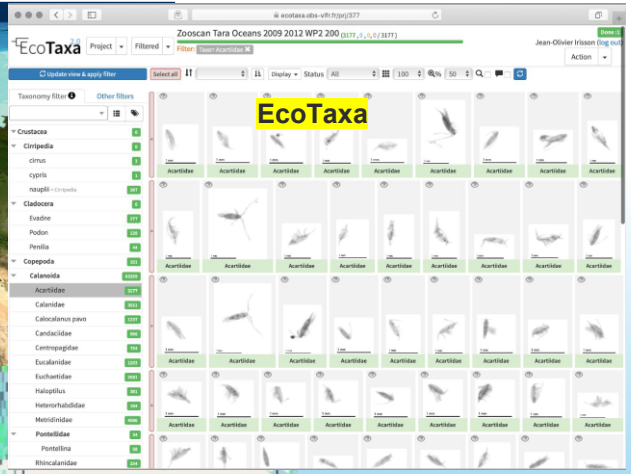
Blue Cloud Discovery and Access service

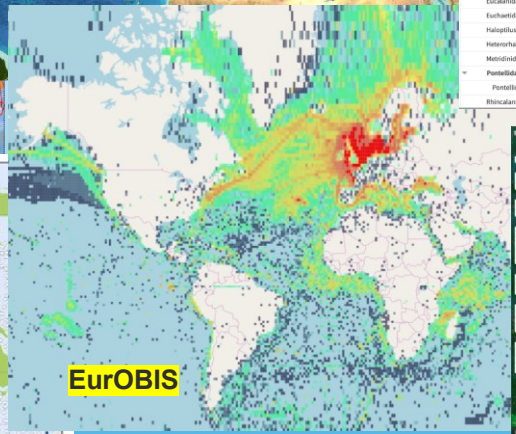
- **Facilitates users**:
  - Federated search for discovering interesting data sets (currently more than 10 million) in a common way
  - Federated retrieval of identified data sets using a shopping basket mechanism
  - Download of data sets or push to Blue-Cloud VRE
- **Facilitates managers of Blue Data Infrastructures**:
  - Wider outreach to potential users
  - Stay informed about data requests and users for their repository
  - Periodic reporting of downloads from their repository

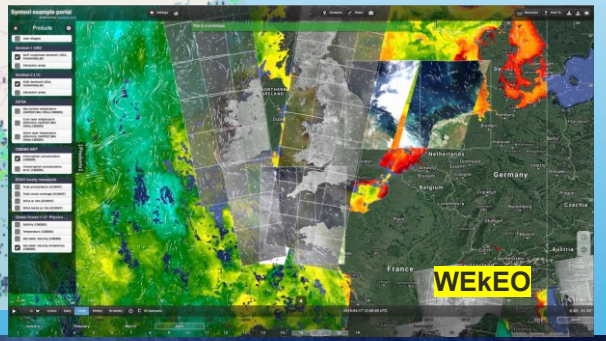
Illustrations of data coverage

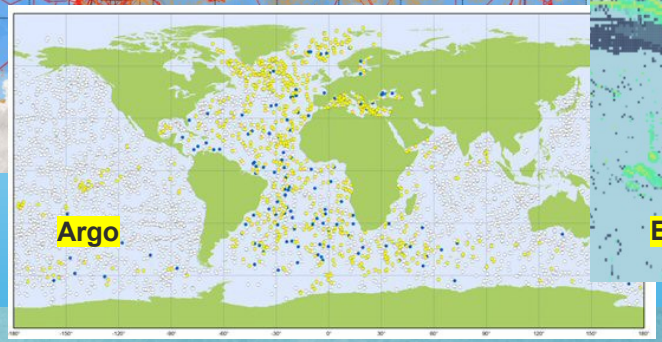












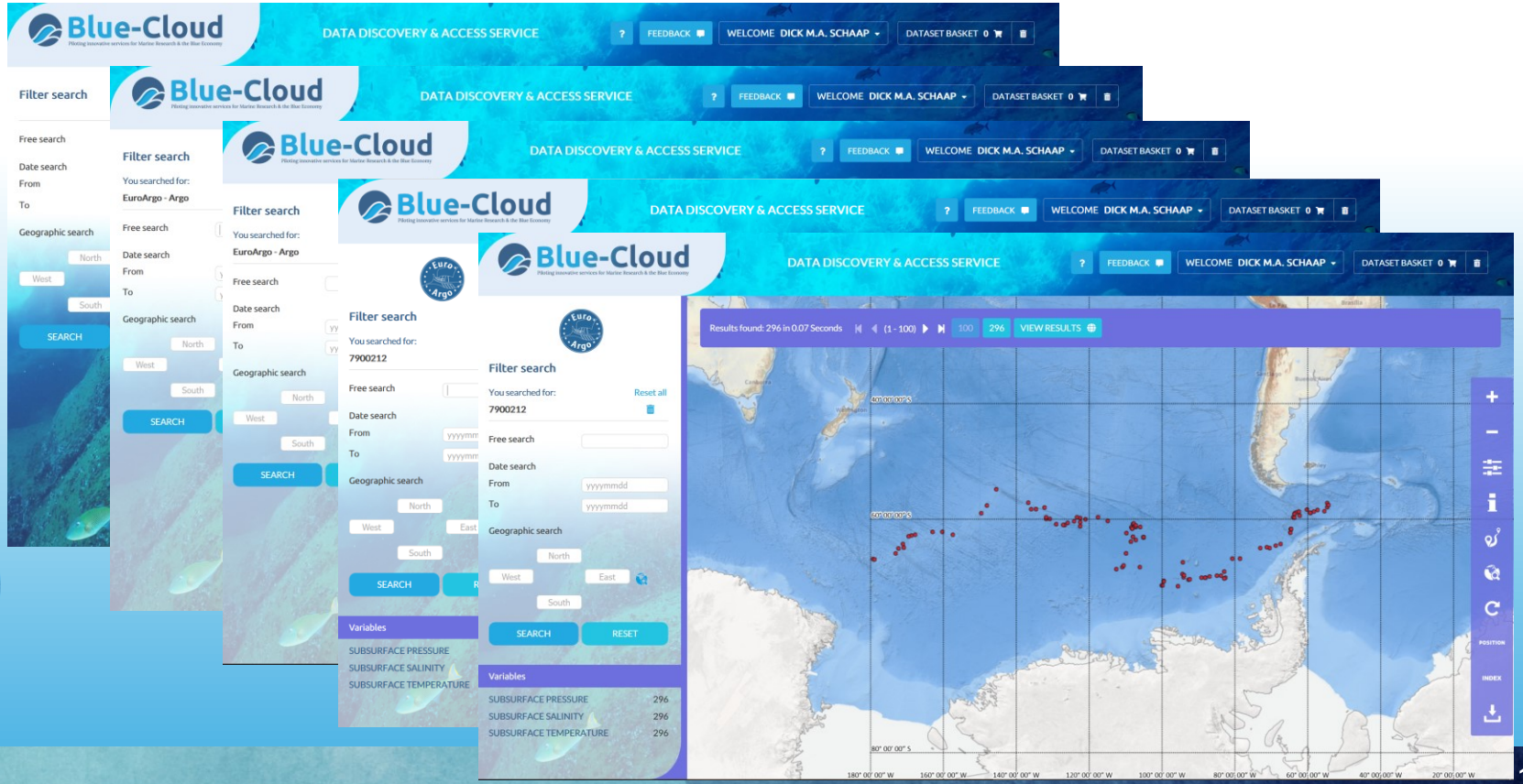
DD&AS conceptual approach

- **Federated discovery and retrieval** of data sets and data products from the Blue Data Infrastructures

- **Concept of two-step search approach**:
  - First step: identifying interesting data collections and products with few criteria
  - Second step: drilling down with more criteria to select specific data at granule level, where possible, otherwise at collection/products level

- Metadata and Data Brokerage services interacting **Machine-to-Machine** with web services and APIs as provided and operated by the Blue Data Infrastructures

DD&AS Dialogue



Level 2 Interfacing - Protocols

SeaDataNet	Dedicated API
SeaDataNet Products	OGC CSW service
EMODnet Chemistry	OGC CSW service
EuroArgo - Argo	Dedicated API
EurOBIS – EMODnet Biology	DCAT service
Ecotaxa	Dedicated API
ELIXIR - ENA	Dedicated API
ICOS Marine	SPARQL service
SOCAT	ERDDAP service

Blue-Cloud VRE

Collaboration

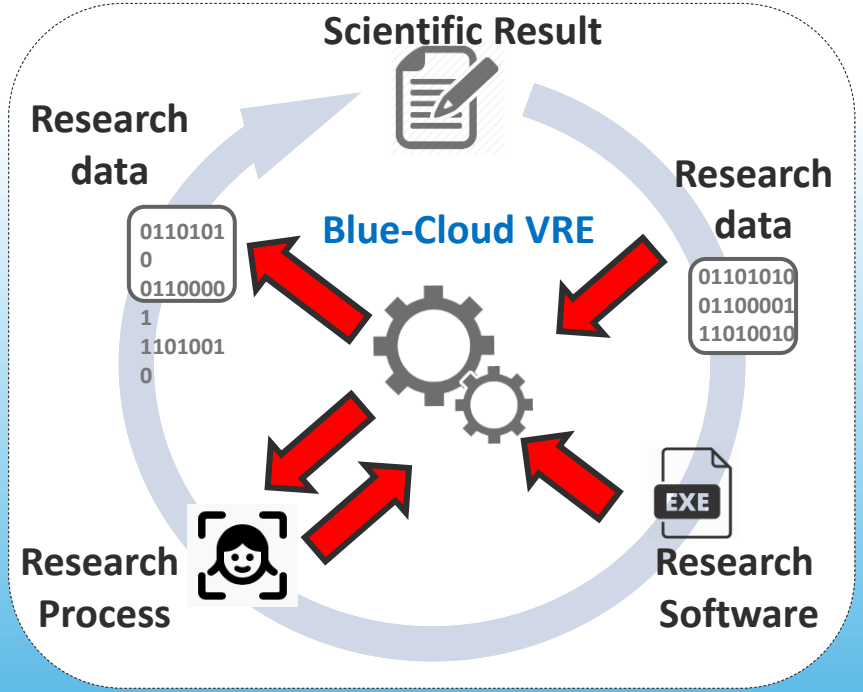
Sharing

Reuse

Reproducibility

Blue Cloud VRE promotes Open Science

A SoS to support and promote Open Science



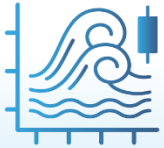
Enable

- Repeat, Reproduce, Reuse, Evaluate
- Active collaboration
- Effective sharing
- Provenance and attribution

Adopt

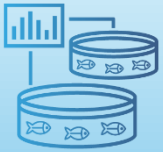
- As-a-service approach
- Standards
- Economy-of-scale to reduce operational costs

5 Virtual Labs at the VRE



Marine Environmental Indicators

Zoo & Phytoplankton EOV products



Aquaculture Monitor

Fish a matter of scales

Plankton Genomics

Conclusions

- Oceans, seas, coastal and inland waters are vital for our societies and the future of our planet. Challenges may be addressed with better and broader use of existing data resources and wider application of web-based analytical services, in support of multidisciplinary and collaborative research.

- The federation of BDIs by the **Blue-Cloud Data Discovery & Access service** has demonstrated its feasibility and indicated that more can be gained by streamlining and expanding the discovery and access processes at connected BDIs, in particular their web services.

- The modular architecture of the **Blue-Cloud VRE** is scalable and sustainable, and has proven to be fit for connecting additional e-infrastructures, implementing and integrating more and advanced blue analytical services. This way it provides a platform for configuring more dedicated VLabs, and targeting broader (groups of) users, both developers and users, interested in elaborating VLab results.

Conclusions

- The **pilot Blue-Cloud project** has confirmed that the EU marine community is aware of this potential and the role the Blue-Cloud infrastructure and its approach can play in accelerating knowledge and science-based solutions to aquatic challenges.

- This has motivated to prepare and submit a successful bid for a **Blue-Cloud 2026 project** to build more momentum for Open Science in the aquatic domain, capitalising on Blue-Cloud's digital assets, and further evolving these for integration and wider user uptake via the Blue Data Infrastructures (RIs), EOSC and other key EU initiatives, such as EMODnet, Copernicus Marine, and Digital Twins of the Oceans (DTO).

Blue-Cloud 2026

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

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

BC2026 will start January 2023 'SO STAY TUNED!'

2022

Unlocking Open Science in support of the EU Green Deal

Blue-Cloud

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Final Conference