

Deliverable D6.3

## **Clustering Event Nr 2**



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## DELIVERABLE

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Table 1: Document Information.

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## 1. Publishable summary

This report details the methodology, objectives, and key discussion points from Clustering Event Nr 2 of the EOVS Network. Clustering Event Nr 2 was a collaborative, cross-project meeting that brought together European initiatives working on ocean observation, climate, biodiversity, and ecosystem science to strengthen alignment and joint impact. The event provided a dedicated space for sister projects to exchange experiences, connect ongoing activities, and develop shared perspectives on how ocean observations can better support policy, services, and societal needs. Through interactive workshops and structured discussions, participants focused on integrating physical, biogeochemical, and biological observations, advancing EOVS-centric approaches, and identifying practical pathways toward more interoperable and sustained observing systems. This event also supported dialogue between scientific communities and policy actors, helping translate scientific advances into coherent messages relevant to European priorities.

## 2. Clustering Event Nr 2

### 2.1 Introduction and Objectives

#### 2.1.1 Introduction

The first EOVS clustering event, Clustering Event Nr 1, was held in March 2025 in Sopot and was organised by ObsSea4Clim and BioEcoOcean, with an invitation to the BioGeoSea coordinator, as BioGeoSea had not yet started at the time of the event. At this event, the teams discussed a shared understanding of EOVS interdependencies across physics, biogeochemistry, and biology, and demonstrated the value of interactive formats such as EOVS speed-dating and thematic deep dives (e.g., the land–coast–ocean continuum and marine heatwaves). The teams identified key challenges that extend beyond individual projects, including *scale mismatches*, *interoperability gaps*, and *uneven EOVS maturity*. The main outcomes of the meeting were the need for stronger

alignment across European and global frameworks, practical guidance on translating EOVs into indicators and assessments, and more user-focused outreach. A report on the outcomes of this first event is available in open access (<sup>1</sup>).

Clustering Event Nr 2 re-convened the three sister projects, ObsSea4Clim, BioEcoOcean, and BioGeoSea, in a structured, decision-oriented event to link the projects' outcomes to policy developments. Preparation meetings were held before the in-person meeting to agree on objectives and the structure of Clustering Event Nr 2.

The event was held on 20-21 April 2026, back-to-back with the EuroGOOS General Assembly (21-23 April 2026) at the EuroGOOS Headquarters, hosted by the Royal Belgian Institute of Natural Sciences in Brussels. Holding the event back-to-back with the EuroGOOS General Assembly was a strategic choice to ensure that:

- The EOV coordination and development are anchored in the European Ocean Observing System development.
- The EuroGOOS Members, Regional Systems (ROOS), Working Groups, and Task Teams had the opportunity to engage directly with EOV processes to ensure that key stakeholders participate in EOV/ECV developments.

#### **About the EuroGOOS members**

The EuroGOOS Members are national governmental agencies, public research institutions, and operational marine organisations from across Europe that are directly responsible for collecting, managing, and delivering sustained ocean observations and services. They include meteorological and oceanographic institutes, marine research centres, hydrographic offices, and operational service providers that operate in-situ observing platforms and fixed observatories across European sea basins. EuroGOOS Members operate the backbone of Europe's sustained ocean observing system. They provide the long-term, quality-controlled observations

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<sup>1</sup> Lips, I., Olsen, S., Bekier, J., McAdam, R., McCarthy, G., O'Beirne, C., Blanco, A., Karaca, D., Luskow, F., Lepola, N., & Hashim, S. (2025). Clustering Event Nr. 1 (D6.1). Zenodo. <https://doi.org/10.5281/zenodo.15304180>  
<https://zenodo.org/records/15304180>

required to support Copernicus Marine, EMODnet, climate monitoring, safety services, environmental reporting, and scientific research.

## 2.1.2 Objectives and topics discussed

The Clustering Event Nr 2 focused on the following overarching main topics:

- Interoperability of data and indicators;
- Coordination of stakeholder and policy engagement,
- The definition of a legacy pathway anchored in European ocean observing governance through EuroGOOS,
- The gathering of community feedback on the European Ocean Pact and upcoming policy developments <sup>(2)</sup>.

The Clustering Event Nr 2 continued the work carried out during the Clustering Event Nr 1 in order to address the following objectives:

1. Agree on cross-domain EOVS linkages essential to indicators and assessments.
2. Identify concrete steps towards shared best practices, uncertainty handling, and multi-platform & data integration.
3. Define concrete EOVS Network outputs (e.g. joint statements, shared standards, coordinated observation priorities) and clarify handover pathways beyond project lifetimes.
4. Define policy-relevant messages (for further communication at the European Maritime Day and EuroGOOS International Conference, as well as Policy Briefs).

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<sup>2</sup> The Ocean Pact is a comprehensive strategy to better protect the ocean, promote a thriving blue economy and support the well-being of people living in coastal areas.

[https://oceans-and-fisheries.ec.europa.eu/european-ocean-pact\\_en](https://oceans-and-fisheries.ec.europa.eu/european-ocean-pact_en)

### 2.1.3 About the Sister Projects - EOVS Network

**ObsSea4Clim**, **BioGeoSea**, and **BioEcoOcean** form a formal collaboration to establish a European EOVS/ECV Network <sup>(3)</sup> to promote multidisciplinary ocean observing across the physical, biogeochemical, biological, and ecosystem domains. The collaboration aims to align observing requirements and system capabilities, enhance interoperability and standardisation, and support the uptake of project outcomes into European and global observing and assessment frameworks, thereby reinforcing integrated climate, biodiversity, and ocean health assessments. The network also serves as a forum for the sister projects to maximise impacts through coordinated activities and communication, including the dissemination of project results and stakeholder engagement. The section below provides a short overview of the three clustered projects.

#### **BioEcoOcean, Co-Creating Transformative Pathways to Biological and Ecosystem Ocean Observations**

Cordis: <https://cordis.europa.eu/project/id/101136748>

The BioEcoOcean project aims to deliver a foundational change in biological and ecosystem ocean observation by co-creating the **Blueprint for Integrated Ocean Science (BIOS)**. BIOS is a question-based, non-prescriptive tool designed to guide ocean observing programmes across the full value chain—from planning and data collection to data management, analysis, and policy application—while supporting workflows aligned with the FAIR Data Principles. By promoting holistic thinking, cross-sector communication, and collaboration, BioEcoOcean strengthens coordination within the ocean observing community and accelerates the implementation of **Biology and Ecosystems Essential Ocean Variables (EOVs)**. A central focus of the project is to improve understanding of the links among ocean biodiversity, biogeochemistry, and climate through interdisciplinary approaches and advanced technologies.

Co-creation with stakeholders at local, regional, and global levels underpins the project, ensuring that outcomes are relevant and beneficial to policymakers, industry, civil

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<sup>3</sup> Lips, I. (2025). A European EOVS/ECVs network promoting multidisciplinary observing (Milestone MS4). Zenodo. <https://doi.org/10.5281/zenodo.15774806>

society, and the scientific community. BioEcoOcean also prioritises capacity building and collaboration with global ocean observing initiatives to support the widespread adoption of co-produced standards and methodologies.

### **BioGeoSea, Enhancing Biogeochemical Essential Ocean Variables for European and Global Assessments**

Cordis: <https://cordis.europa.eu/project/id/101216427>

The BioGeoSea project aims to enhance ocean biogeochemical observation by strengthening **Biogeochemical Essential Ocean Variables (BGC EOVS)** and delivering integrated, high-quality knowledge to support science, policy, and sustainable ocean management. It advances observation systems, data integration, modelling, and indicator development to better track key ocean processes, including ocean acidification, deoxygenation, carbon cycling, and greenhouse gas fluxes.

BioGeoSea supports European and global assessments of ocean change and ecosystem health by improving interoperability and transforming trusted observations into actionable insights. The project combines observations, models, and innovative data products to close critical knowledge gaps in ocean biogeochemistry and provide timely, transparent information for decision-making.

The project works closely with international observing initiatives and stakeholders across science, policy, and the blue economy to ensure that its outputs are relevant, usable, and widely adopted, contributing to a more coordinated and effective global ocean observing system.

### **ObsSea4Clim Ocean observations and indicators for climate and assessments**

Cordis: <https://cordis.europa.eu/project/id/101136548>

ObsSea4Clim aims to strengthen sustained and multipurpose ocean observations to better meet European and global climate needs. The project focuses on improving the use of **Essential Ocean Variables (EOVs)** and **Essential Climate Variables (ECVs)** within the **Rolling Review of Requirements (RRR)** framework to support more coherent, cost-effective, and fit-for-purpose observing systems.



By enhancing regional ocean indicators, advancing Earth System Models through improved integration of EOVs and ECVs, and promoting interoperable and standardised data practices for both in situ and satellite observations, ObsSea4Clim delivers improved climate assessments, projections, and actionable indicators for sustainable development. Its work is structured around four building blocks: strengthening the EOV/ECV framework, developing regional indicators, designing national multipurpose observing systems, and integrating these efforts into European and global initiatives.

## 2.2 Preparation of the Clustering event: Online Workshop

### 2.2.1 Objectives and Structure

This online workshop was organised on 31 March 2026. Over forty participants took part in the workshop across the three sister projects. The EOV Network Workshop was explicitly designed as a practice-to-policy bridge, bringing together BioEcoOcean, BioGeoSea and ObsSea4Clim to:

- Map what is already being done across projects and how this contributes to EU ambitions - “existing actions”
- Identify joint, feasible actions within the current project lifetimes
- Articulate a “wishlist” of policy and governance support required to unlock integration and operationalisation in practice.

The workshop was organised to ensure continuity across the discussions as follows:

- Introduction to the workshop and setting the policy scene.

Three rounds in breakout groups to address actions already underway in the sister projects; concrete joint activities to enhance collaboration and impact, and the translation of the barriers identified into policy-relevant recommendations.

- Wrap up and conclusions.

This design made the workshop particularly strong in surfacing systematic bottlenecks and structural barriers rather than technical gaps.

### 2.2.2. Main discussions and outcomes

#### **Mapping current activities and actions to EU Policies**

Participants identified a strong and already substantial contribution of the sister projects to EU policy priorities, in particular the European Ocean Pact, the European Ocean Observation Initiative / OceanEye <sup>(4)</sup>, the Marine Strategy Framework Directive (MSFD), and related Arctic and climate strategies as:

- Protecting ocean health through biodiversity, biogeochemical and physical indicators.
- Strengthening ocean knowledge via long-term observing networks, indicators, and narratives.
- Supporting sustainable ocean governance through interoperability, standardisation, and regionalisation of indicators.
- Development and refinement of Essential Ocean Variables (EOVs) for regional and global assessments.
- Contribution to integrated observing systems supporting EMODnet, Copernicus, Digital Twins and assessments.
- Improvements in metadata, calibration, uncertainty handling, and best practices.

Participants noted that many project activities directly support the European Union's ambitions, but that this link is not always explicit or visible, highlighting the need for clearer articulation of policy relevance in project outputs.

#### **Priority joint actions across sister projects to increase collaboration and impact**

The workshop generated consensus around a number of feasible, high-impact joint actions to be pursued within the current project lifetimes. These are listed below.

##### **1. Cross-project alignment on indicators**

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[https://commission.europa.eu/news-and-media/news/oceaneye-reinforcing-ocean-observation-and-protection-2026-03-02\\_en](https://commission.europa.eu/news-and-media/news/oceaneye-reinforcing-ocean-observation-and-protection-2026-03-02_en)

- Co-development of indicators addressing compound events (e.g. marine heatwaves), combining physical, biogeochemical and biological observations.
- Stocktake of available and missing data required to operationalise such indicators.
- Alignment with GOOS indicator development and EOVS specification sheets.

## **2. Harmonisation of terminology, standards and practices**

- Exchange and alignment on vocabulary, definitions and specification sheets across projects.
- Use of shared standards and best practices as a foundation for interoperability.
- Connection to existing efforts, such as the Ocean Best Practices System.

## **3. Demonstration cases to show the value of integration**

- The ocean carbon cycle and marine heatwaves were identified as strong cross-cutting examples to demonstrate the added value of integrated EOVS.
- Proposal for a targeted workshop or case study to link observations, indicators, models and policy use.

## **4. Strengthened linkage with GOOS**

- Ensuring that project outputs feed consistently into GOOS panels and frameworks.
- Using GOOS as a mechanism for continuity beyond project lifetimes.

These actions were identified as key to moving from coordination to a more impactful, visible and practical integration.

## **From barriers identified into policy-relevant recommendations**

The third round of breakout groups set a number of policy-facing messages:

- **Sustained funding, coordination and governance**

- Long-term ocean observation cannot rely on short-term research projects alone.
- Coordinated EU–Member State funding mechanisms are required to sustain core observing systems (e.g. Argo, BGC Argo, biodiversity observations).
- Need for EU-level coordination bodies or mechanisms for ocean observing.
- Proposals discussed during this round ranged from reinforced coordination under OceanEye to, longer term, a European Ocean Observing Agency similar to the European Environmental Agency.
- **Science-Policy interface and reporting**
  - EOVs should be explicitly embedded in MSFD and other reporting frameworks.
  - Member States need guidance, incentives, and mandates to consistently adopt EOV-based approaches.
  - Strong support for a recurring, structured science–policy dialogue (e.g., stocktake, guideline development or assessment processes).
- **Integration and FAIR/CARE principles**
  - Participants emphasised that data pipelines, uncertainty documentation, and credit mechanisms must be treated as integral parts of ocean observing, not as optional add-ons.
  - Dedicated instruments (coordination actions, targeted funding, shared tools) are needed to enable real integration across domains while accounting for the different levels of maturity in physics, biogeochemistry, and biology.
  - Integration shall be supported by policy mandates to move from voluntary to operational.

## **Overarching conclusions and outcomes**

The workshop discussions highlighted that:

- The scientific capability for integrated ocean observation is largely in place.
- The main barriers are structural: governance, incentives, funding continuity, and policy embedding.
- The Essential Ocean Variables (EOVs) provide a credible and widely supported framework, but must be better anchored in EU policy instruments.

The identified collaborative and impactful joint actions are crucial to:

- Raise awareness of the importance of EOVs and Indicators, and demonstrate added value.
- Support integration, operationalisation and engagement with policymakers,
- Build momentum towards sustained, operational observing systems,

The Workshop successfully served as a bridge between science and policy, and as a prelude to deeper prioritisation and decision-making at the upcoming in-person clustering event.

## 2.3. Clustering Event Nr 2

### 2.3.1 Overall Structure

The event was structured into three sessions spread across two half-days (20-21 April 2026). This section highlights the overall structure of the event. Details are provided for each session in 2.3.2.

**Session 1: Lessons learned from Clustering Event Nr 1 and from the March online Workshop.** This interactive session focused on synthesising the outcomes and main outputs of the previous events in preparation for Clustering Event Nr 2. In addition, this session analysed the three sister projects' upcoming deliverables, milestones, and events to identify synergies and opportunities for collaboration.

**Session 2: Policy messages alignment.** This session was structured as a brainstorming session, building on the policy links and messages drafted during the workshop on 31 March 2026. During the session, the three sister projects explored their contributions to

the Ocean Pact, focusing on the Ocean Observation Initiative, the R&I Strategy <sup>(5)</sup>, and the Ocean Eye. The outcome of this session was presented in the Panel Discussion - “EOV Network” held the following day.

**Session 3: Interaction with EuroGOOS Members and European Commission representatives.** This interactive session was structured in two panel discussions. The first one was focused on the EOV projects' outcomes, feedback into sustained observing systems, their joint policy messages and their legacy aspirations. The second panel discussion, “*EU Policy Supporting Ocean Knowledge*”, was focused on the latest and upcoming policy developments linked to the Ocean Pact and Copernicus. This panel was shared between European Commission Officers from DG MARE and DG RTD, as well as the European Environmental Agency.

The outcomes of the first two sessions were used in the third session. The third session included a broader audience, e.g., EuroGOOS Members, key players in the European ocean observation landscape, and European Commission policy officers. The recommendations developed and the areas for action identified during these sessions are instrumental in informing policymakers, enhancing sustainable ocean management, and increasing the coherence of the global ocean observation community.

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<sup>5</sup> Consultation on the [European ocean research and innovation strategy](https://oceans-and-fisheries.ec.europa.eu/european-ocean-pact_en); about the European Ocean Pact: [https://oceans-and-fisheries.ec.europa.eu/european-ocean-pact\\_en](https://oceans-and-fisheries.ec.europa.eu/european-ocean-pact_en). Consultation on the European Ocean Act [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/16238-European-Ocean-Act\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/16238-European-Ocean-Act_en)



**Fig. 1:** Pictures from Clustering Event II: Picture 1 participants of the first two sessions on 20 April. Picture 2 Speakers of the EOJ Panel on 21 April. Pictures: Lina Mtwana Nordlund.



### 2.3.2 Day 1 - 20 April 2026 Sister Projects Internal Workshop

#### **Workshop Report**

##### *Objectives*

The afternoon session aimed to:

- Build on Clustering Event I and the 31 March 2026 open workshop.
- Align deliverables, timelines, and collaboration across ObsSea4Clim, BioEcoOcean, and BioGeoSea.
- Converge on joint policy messages in support of the Ocean Pact, Ocean Observation Initiative, and Ocean Eye.
- Prepare common positioning and questions for European Commission interactions on Day 2.

#### [Session 1: Lessons learned from Clustering Event Nr 1 and Online Workshop](#)

##### **Objectives of the Session**

Take stock of lessons learned from Clustering Event Nr 1 and the 31 March 2026 Online Workshop. In addition, this session focused on aligning sister projects' priorities and on collaboration in project deliverables.

##### **Main Points of Discussion**

###### **1. Lessons learned from Clustering Event Nr 1**

- Clustering Event Nr 1 confirmed that Europe's ocean observing system is challenged by structural fragmentation. It was highlighted that ocean observing systems remain fragmented across disciplines and infrastructures. It was stressed that biological and ecosystem observations are strongly underrepresented, with only a small fraction of these data being FAIR and reaching the European data pipelines.
- Participants stressed the role of Essential Ocean Variables (EOVs) as the backbone of integrated ocean observation, providing a global framework, developed under GOOS, that encompasses physics, biogeochemistry, and biodiversity. EOVs enhance harmonisation across disciplines, support the



development of comparable indicators, and can be useful in linking observations to policy.

- Marine heatwaves <sup>(6,7)</sup> were identified as a shared, cross-domain use-case phenomenon, demonstrating the need for integrated observing systems, as their frequency and intensity across European seas are increasing, with impacts on ecosystems and socio-economic activities. Marine heatwaves provide a concrete narrative that links EOVs and indicators and communicates impacts in a policy-relevant and accessible way. It was noted that surface observations alone are insufficient to predict and assess the impact of marine heatwaves. There is a need for Integrated surface–subsurface and physical–biogeochemical–biological observations.
- The main barriers identified during the Clustering Event Nr 1 were:
  - Fragmentation across ocean observing systems
  - Lack of standardisation and interoperability
  - Scale mismatches, in particular across domains, e.g. physics vs species biology
  - Limited integration of biological observations into models and pipelines

## **2. Lessons learned from the preparatory online EOv workshop**

- The online workshop reinforced that the European Ocean Observation System needs not just more data but a system-level change to enable integration across observing systems, domains, and infrastructures.
- The workshop highlighted a strong inclination to collaborate across BioEcoOcean, ObsSea4Clim, and BioGeoSea, with an emphasis on actions achievable within the project lifetimes. Integration of physics, biogeochemistry, and biology, harmonisation, and policy relevance were identified as topics for collaborative action.
- The workshop discussions confirmed the main structural barriers already identified in Clustering Event Nr 1, such as fragmentation, particularly across

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<sup>6</sup> Darmaraki, S., et al. (2024). Marine Heatwaves in the Mediterranean Sea: A Literature Review. *Mediterranean Marine Science*, 25(3), 586–620. <https://doi.org/10.12681/mms.38392>

<sup>7</sup> Lips, I., Olsen, S., Bekier, J., McAdam, R., McCarthy, G., O'Beirne, C., Blanco, A., Karaca, D., Luskow, F., Lepola, N., & Hashim, S. (2025). Clustering Event Nr. 1 (D6.1). Zenodo. <https://doi.org/10.5281/zenodo.15304180>  
<https://zenodo.org/records/15304180>

domains, infrastructures, and Member States; lack of standardisation and interoperability; over-reliance on short-term project-based funding; and weak policy uptake and embedding of EOVs and Indicators.

- The workshop highlighted the contributions and links from the sister projects to ongoing policy efforts at the European level under the European Ocean Pact, particularly under the Ocean Observation Initiative and contributions to integrated observing systems supporting EMODnet, Copernicus, Digital Twins and Global and regional assessments. However, these contributions are not always explicit and strengthening the visibility of the project outputs is necessary.

## Session 2: Policy messages alignment

### Objectives of the session

Building on the outcomes of the online workshop and Session 1, this session focused on synthesising and aligning key policy messages across the sister projects. The session identified policy areas and cross-cutting topics that will be addressed through policy recommendations by the sister projects, either in joint or individual deliverables.

### Main points of discussion

#### 1. Strategic importance of ocean observation and EOVs

- Ocean observation is at a critical strategic moment in Europe, linked to the evolving policy landscape, namely The Ocean Pact, including the Ocean Observing Initiative, as well as communication on the Ocean Eye and developments on the Digital Twin of the Ocean.
- Essential Ocean Variables (EOVs) were reaffirmed as the foundational building blocks for global and regional assessments, model validation and the development of ocean and climate indicators. In addition, EOVs are key to developing policy-relevant information products, such as contributions to Operational Oceanography and Climate services offered by Copernicus, as well as policy briefs.

- A challenge was identified in the limited awareness and uneven understanding of EOVs beyond specialised scientific communities, particularly in the biological and ecosystem domains, compared with physics and biogeochemistry.
- Participants agreed that science–policy interactions remain insufficiently structured and too episodic. There is a need to present clear pathways from EOVs-Indicators to policy-relevant information and to foster continuous dialogue among observing communities, policymakers, and final users.

## **2. Priority Policy messages**

- Fragmentation is the core policy challenge. Participants agreed that Europe already has strong ocean observing assets, expertise, and infrastructures, but their impact is reduced by fragmentation across domains (physics, biogeochemistry, biodiversity), governance levels, funding streams, and data practices. Addressing fragmentation is therefore the principal policy priority underpinning the Ocean Pact, OceanEye, and forthcoming Ocean Act.
- Coordination must be functional and focus on functions along the observation-to-service chain (observation, calibration, data management, integration, indicators, services), not on restructuring institutions or infrastructures. Coordination should target only those areas where it creates clear added value, avoiding expectations of centralised control and instead enabling transparency, shared planning, and agreed interfaces.
- Integrated observations are essential to understand ocean–climate–ecosystem interactions. There is a need to design observing systems that collect physical, biogeochemical, and biological variables together and address partial and temporal-scale mismatches, particularly between physics and biological observations. Improved integration is critical for ecosystem responses, understanding, and forecasting of compound events such as marine heatwaves.
- Interoperability should be addressed at the governance level, not as a technical barrier. It was highlighted that there was a lack of harmonisation in methodologies, vocabularies, metadata and uncertainty reporting across disciplines. In addition, there are recurrent gaps in FAIR implementation, particularly for biological and ecosystem data, due to a lack of incentives and

recognition for data providers. To strengthen indicator frameworks, models, and services such as digital twin applications, improved interoperability is crucial.

- Europe's ocean observing system is still largely reliant on short-term, project-based funding, which is incompatible with the long-term nature of climate, biodiversity, and ecosystem monitoring. There is a need for sustained, coordinated funding mechanisms at the EU and Member State levels for core observing infrastructures, including coastal and biodiversity observations. It was highlighted that there is a lack of recognition that critical services (e.g., digital twins, early warning systems) fundamentally depend on continuous observations.

### Session 3: Day 1 outcomes summary and exchange with European policymakers and EuroGOOS Members

#### **Objectives of the session**

Building on the shared messages and outcomes agreed upon during the previous day, this session had a double focus:

- Illustrating the shared policy messages and discussing high-level project outcomes and legacy ambitions with EuroGOOS Members representatives and policymakers to foster their uptake in observation system strategy and relevant policy initiatives.
- Promoting exchange between policymakers and project representatives on policy developments linked to the Ocean Pact, Ocean Eye and EU flagship initiatives such as Copernicus.

#### **Main points of discussion**

##### **3. Project output and legacy, shared policy messages**

- Projects' contributions to the advancement of GOOS. Overall, the three projects are contributing to GOOS by extending the EOVS framework and its use in indicators, and promoting cross-discipline integration and harmonisation, all the while extracting related requirements to feed back into system design and the development of Ocean Best Practices. Particular emphasis is put on regional

indicators and the regionalisation of global indicators, as well as their use in climate assessments (ObsSea4Clim). EOVs are revisited and advanced, taking into account the needs of socio-economic stakeholders, updating their specification sheets, and making them more relevant to the broader value chain and decision-making (BioGeoSea). The critical bottlenecks of data scarcity and observing system fragmentation are further addressed through the development of data synthesis products (BioGeoSea). Particular attention is given to advancing less mature observing systems, particularly in biology and ecosystems, by updating their EV specification sheets, promoting capacity building and outreach, and advancing data infrastructures, with a focus on data pipelines to make observations more usable (BioEcoOcean).

- Challenges and gaps faced by the projects. Certain observation networks have suffered from a decline in capacity and output in recent years, due to reductions in the number of stations and declines in monitoring programmes and funding. This poses a concrete risk of losing observational capabilities at a time when system resilience is jeopardised at the geopolitical level, and monitoring the effects of the triple planetary crisis becomes increasingly crucial. In this scenario, stakeholders are increasingly focusing on maintaining existing systems rather than expanding them. These criticalities can first be addressed by identifying fragilities in observing networks and fostering coordination among actors, particularly by improving the spatial and temporal coordination of campaigns, increasing interoperability and standardisation of observations, and enhancing collaboration to avoid duplication and improve coverage. Further challenges include low awareness and uptake of EOVs within scientific communities and across the entire value chain; limited estimates of uncertainty; low consistency in methodologies and standards, including for data and metadata; and difficulties in transferring best practices across disciplines.
- Opportunities for the EU to support advancements beyond the three projects. The EU can first and foremost promote and support the message that ocean observations must be treated as critical infrastructure, not a cost, given their crucial role in ocean health, food security, and transport. This calls for long-term,

stable investment models, beyond project-based funding. In this picture, the EU can provide an additional funding stream for components identified as critical to national observing systems, promoting effective coordination at the European level and supporting GOOS structures. The EU can further incentivise the development and deployment of cost-efficient technologies and further incentivise data sharing. To ensure an independent and resilient observation system, stronger links with operational services need to be fostered; however, the EU primarily needs to build a resilient, globally characterised observing system, e.g., via a European Agency for Ocean Observing.

#### **4. Outcomes of the exchange on policy priorities**

- EU-level governance of ocean observations was presented as a key priority by European Commission representatives, with the Ocean Act, currently in draft form, aiming to establish a Member State Forum with some decision-making authority to coordinate efforts and build on existing national capabilities. One of the objectives of this new governance structure is to address the high degree of fragmentation and governance complexity that currently exists and operates at multiple levels: sub-national, national, regional, and Union-wide. The new structure should further ensure adequate representation of all disciplines and observing networks, particularly those that are less mature.
- In light of geopolitical developments, ensuring the resilience of the ocean observing system is a key priority that needs to be addressed in the short term, and a Horizon Europe topic is in the works to address the urgency.
- Investments into new technologies, particularly in the development and deployment of cost-efficient sensors and platforms, are a key need to ensure the EU's ability to support a resilient observing system. Technology needs to be supported from fundamental research through SME scaling and large-scale deployment. In this respect, actions also need to be put in place to ensure the operationalisation and integration of data services, as well as the harmonisation of data products.
- Overcoming the dichotomy between research and operations is crucial, and new governance and technological solutions should enable the operationalisation of

marine research infrastructures, while ensuring that the capacity to perform fundamental research is not significantly affected.

### 2.3.3 Conclusions

Clustering Event Nr 2 brought together the sister projects in a focused, interactive setting to reflect on lessons learned from earlier clustering activities and to move toward more coordinated, actionable outcomes. Through internal workshops, joint discussions, and cross-disciplinary exchanges, the event created space to align ongoing work, compare approaches, and prepare shared messages for engagement with European policy actors.

The discussions confirmed a shared understanding that Europe's main ocean-observation challenge lies in system-level fragmentation rather than scientific capacity. Participants converged on the need for integrated, sustained, and interoperable observing systems, capable of linking physical, biogeochemical, and biological domains and of supporting climate, biodiversity, and ocean-health priorities. The event highlighted EOVC-centric approaches as a common framework for enabling this integration by connecting observations to indicators and services and strengthening policy relevance.

Clustering Event Nr 2 also reinforced that progress depends on making better use of existing coordination mechanisms, securing long-term support beyond project funding, improving interoperability and data governance, and strengthening science-policy interfaces. Overall, the event positioned the sister projects as joint enablers of a more coherent and resilient European ocean observing system, with a shared commitment to continue working together through coordinated actions, common narratives, and aligned policy contributions.

The Clustering Event Nr 2 was a significant milestone for the three sister projects, highlighting deliverables and joint actions to enhance the impact of the results produced by the individual projects. As the Global and European efforts continue to push for an integrated ocean observing system, events like these are essential in

identifying areas for action and recommendations to ensure that research outputs are timely feed into policy developments.

### 3. Contribution to the ObsSea4Clim objectives

This deliverable contributes to the following specific objectives of the project.

SO3	<b>To create an interoperable data ecosystem serving multidisciplinary needs.</b>
	<p>The event enabled coordinated discussions on how national and regional observations that support operational services, climate monitoring, early warning, and ocean health can be aligned on common EO/ECV definitions, standards, and workflows. Through cross-project exchanges on indicators, regional application areas, and data interoperability, ObsSea4Clim supports domain integration by linking physical application areas—such as ocean heat content, circulation, and extremes—to broader ecosystem and biogeochemical phenomena. The Clustering Event strengthened the development of a transparent and balanced ocean indicator framework that supports the production of multidisciplinary evidence outputs.</p>
SO5	<b>To place Europe at the forefront of the global coordination of the broader ocean-climate nexus.</b>



The Clustering Event Nr 2 supported the objective of placing Europe at the forefront of global coordination of the broader ocean–climate nexus by convening leading European initiatives and communities working across ocean observation, climate indicators, and biodiversity assessments. The event provided a structured science–policy interface in which ObsSea4Clim, together with sister projects, aligned approaches and priorities around an EO/ECV-centric framework, strengthening the integration among physical, biogeochemical, and biological observations. By linking project outputs to current policy priorities, Clustering Event Nr 2 also supported European leadership in the upcoming policy development and the European Digital Twin of the Ocean, ensuring that European observing assets, standards, and indicators underpin future global ocean–climate applications and science-policy dialogues.

## 4. Presentations of the workshop

All the presentations of the workshop are available in Zenodo: Sala Perez, M., Olsen, S. M., Bekier, J., Mtwana Nordlund, L., Hashim, S., Lepola, N., Eparkhina, D., Chellini, G., Blanco-Fernández, A., Tanhua, T., Speich, S., Köstner, N., & Telszewski, M. (2026, May 21). EO/ECV Network Clustering Event Nr 2: Collection of the presentations. Zenodo. <https://doi.org/10.5281/zenodo.20325734>

## 5. References

Lips, I., Olsen, S., Bekier, J., McAdam, R., McCarthy, G., O'Beirne, C., Blanco, A., Karaca, D., Lüsrow, F., Lepola, N., & Hashim, S. (2025). Clustering Event Nr. 1 (D6.1). Zenodo. <https://doi.org/10.5281/zenodo.15304180> <https://zenodo.org/records/15304180>

Lips, I. (2025). A European EO/ECVs network promoting multidisciplinary observing (Milestone MS4). Zenodo. <https://doi.org/10.5281/zenodo.15774806>

Darmaraki, S., et al. (2024). Marine Heatwaves in the Mediterranean Sea: A Literature Review. *Mediterranean Marine Science*, 25(3), 586–620.  
<https://doi.org/10.12681/mms.38392>