

## **EOOS Strategy 2018-2022**

*“To make ocean observation more sustainable it needs to become a public utility. We need to do what going from gas lamps to electricity did for the Industrial Revolution: we need to turn on the lights in the ocean.”* John Bell, European Commission, DG Research and Innovation, Marine Directors meeting with Commissioner Vella, July 2018.

*This strategy has been prepared by the EOOS Steering Group with significant community input. It builds on the EOOS Consultation Document 2016 (launched at the dedicated EOOS event at the European Parliament in September 2016) and an open stakeholder consultation on EOOS during December 2016 and January 2017. These results, together with EOOS Steering Group and EOOS Advisory Committee feedback and participants’ inputs at the interactive EOOS Forum 2018 (8 March, Brussels), were taken into account when drafting the Strategy and Implementation Plan 2018-2022. These drafts were opened for a stakeholder consultation between 25 April and 15 June 2018. Following updates and approval by the EOOS Steering Group, the final 2018-2022 strategy and implementation plan will be launched at the EOOS Conference on 21-23 November 2018.*

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*<http://www.eoos-ocean.eu/>*

## What is EOOS?

The European Ocean Observing System, EOOS, is a coordinating framework designed to align and integrate Europe's ocean observing<sup>1</sup> capacity for the long term; to promote a systematic and collaborative approach to collecting information on the state and variability of our seas and oceans; and to underpin sustainable development, protection and conservation of the marine environment and its resources<sup>2</sup>.

EOOS is not a new observation network. It will not do what other networks do, but will strengthen coordination and dialogue between systems and networks. EOOS adds value by providing a central focal point for strategy, stakeholder engagement and innovation across Europe's diverse ocean observation and monitoring communities. As an inclusive, voluntary federation, EOOS will contribute to global efforts in ocean observing such as GOOS<sup>3</sup> and GEOSS<sup>4</sup>, and international policies including the UN 2030 Agenda for Sustainable Development<sup>5</sup> and climate change agreements such as the COP21 Paris agreement<sup>6</sup>. And with a European focus, EOOS contributes to a number of key European Union policies such as the Marine Strategy Framework Directive (MSFD)<sup>7</sup> and Common Fisheries Policy (CFP)<sup>8</sup>.

EOOS focuses on the *in situ* European ocean observation capability with observations taken directly in the water, seafloor or by airborne instruments. This includes the infrastructure and people required to deliver ocean observations and encompasses coastal, open ocean, deep sea and seafloor data collection efforts across a multidisciplinary, ecosystem approach. EOOS will also take a broad and inclusive perspective in terms of types of observations and stakeholders included in its scope. Essentially, EOOS will take account of all systematic efforts to collect marine environmental data from the ocean. This includes highly automated physical observations, through geological information, bathymetric surveys, ocean chemistry, and biological data collection, most of which is not automated (e.g. fisheries surveys, benthic video footage, etc.) It will include both real-time (or near real-time) and delayed modes of data collection and both research-driven and operational data collection.

EOOS focuses on ocean observation efforts in European waters and bordering sea basins since this is where the coordination is most required. This is set in the wider context of European capability worldwide.

EOOS links with space-based (satellite) systems, in the context of wider earth system observations e.g. climate and marine and earth system modelling efforts. It also links, and aligns, with existing initiatives such as the European Marine Observation Data Network (EMODnet) as the long-term data management and sharing platform of EOOS, SeaDataNet as a European network of National ocean data centers and the Copernicus Marine Environment Monitoring Service (CMEMS) which provides key products and services to an established user community. EOOS will consolidate the upstream *in-situ* observing infrastructure that is required by all these initiatives.

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<sup>1</sup> Repeated, regular collection of ocean data for monitoring and/or time-series purposes. Sampling may be automated (by sensors or samplers) or may require human effort.

<sup>2</sup> <http://www.eoos-ocean.eu/>

<sup>3</sup> <http://www.goosocean.org/>

<sup>4</sup> [www.earthobservations.org](http://www.earthobservations.org)

<sup>5</sup> <https://sustainabledevelopment.un.org>

<sup>6</sup> <http://www.cop21paris.org>

<sup>7</sup> [http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index\\_en.htm](http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm)

<sup>8</sup> [https://ec.europa.eu/fisheries/cfp\\_en](https://ec.europa.eu/fisheries/cfp_en)

## EOOS Vision

By 2030, EOOS will make ocean observation a public utility in Europe, by strengthening coordination, strategy and sustainability in ocean observation. This will be achieved with an operational implementation cycle that connects Europe's ocean observing community and offers regular opportunities for stakeholder input to evaluate, co-design and fund capability. Putting the needs of users at its centre, EOOS will promote European leadership and innovation delivering crucial data to drive environmental policy, the blue economy and serve wider society.

## Why Does Ocean Observing Matter?

Today, ocean observing has an unprecedented potential to help meet societal challenges (EuroGOOS, 2016<sup>9</sup>). Across the world, a multitude of observing systems monitor the ocean from the coast to the deep sea. Ocean observing gives us data and information to help manage all of our activities at sea, but also our activities on land through, for example, weather forecasting and climate monitoring; this leads to sound decision-making for societal benefit. Key ocean datasets in near real-time underpin maritime activities, marine resources management, ocean and weather forecasting, assessing ocean health and quality, warnings of and rapid responses to extreme or hazardous events, climate monitoring and prediction. Long-term ocean monitoring across all ocean parameters is also crucial to help track, understand and forecast human impacts and climate change effects on the health of the ocean.

The value of ocean observing has been recognized at the highest international level, among others by the UN Agenda 2030, UN Decade of Ocean Science for Sustainable Development, and G7<sup>10</sup>. Monitoring and implementing the 17 Sustainable Development Goals (SDGs), not least SDG 14 "Life Below Water", will require a systematic and strategic approach to ocean observing, supported by adequate infrastructure and investments.

## What are the Drivers for European ocean observation?

Drivers for ocean observing range from climate and ocean services to marine and wider environmental policies and understanding ocean health (EOOS Consultation Document, 2016<sup>11</sup>). Some examples of known and emerging drivers requiring systematic ocean observation, where EOOS coordination efforts can add value include:

- European policy: a range of European policies (Marine Strategy Framework Directive, Water Framework Directive, Birds and Habitats Directives, Common Fisheries Policy, Integrated Coastal Management Policy and Maritime Spatial Planning Directive);
- Environmental status monitoring and assessment: Europe's Regional Sea Conventions (Helsinki, Oslo-Paris, Barcelona and Bucharest Conventions) are committed to achieving healthy oceans and have sustained monitoring programmes at Regional level which will support several European policies (see above) and the growing demands for sustainable use of resources;
- Global policy: Support and deliver the European contribution for international conventions such as the Convention on Biological Diversity (CBD)<sup>12</sup>, Biodiversity Beyond areas of National

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<sup>9</sup> <http://eurogoos.eu/download/publications/EuroGOOS-Policy-Brief-2016.pdf>

<sup>10</sup> <https://g7.gc.ca/en/official-documents/charlevoix-blueprint-healthy-oceans-seas-resilient-coastal-communities/>

<sup>11</sup> [http://www.eoos-ocean.eu/download/promotional\\_materials/EOOS\\_ConsultationDocument\\_02.12.2016.pdf](http://www.eoos-ocean.eu/download/promotional_materials/EOOS_ConsultationDocument_02.12.2016.pdf)

<sup>12</sup> <https://www.cbd.int/>

Jurisdiction (BBNJ)<sup>13</sup> and assessments (Intergovernmental Panel on Climate Change (IPCC)<sup>14</sup>, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)<sup>15</sup> and the World Ocean Assessment (WOA)<sup>16</sup>;

- Fisheries and aquaculture: with total food demand projected to increase by 60% by 2050 (FAO, 2017), there will be an increasing need to monitor our oceans from the coast to the open ocean to maximize, diversify and sustain fisheries and aquaculture to feed the world population;
- The wider blue economy: the global ocean economy is projected to double in size to \$3 trillion by 2030 (OECD, 2016<sup>17</sup>; Future of the Sea, 2018<sup>18</sup>). In Europe, this 'blue' economy is rapidly expanding from the coast to offshore and deep sea. Marine and maritime industries include tourism, aquaculture, renewable energy and shipping and the potential multi-use of marine space require regular and reliable ocean data, linked to wider earth system monitoring (e.g. weather, climate);
- Pollution including ocean plastics: plastic in the ocean is projected to treble between 2015 and 2025 (Future of the Sea, 2018) and a coordinated approach at European (and global) level is required to clean the ocean and monitor the legacy of plastics and wider pollution;
- Weather forecasting and wider mapping and prediction of ocean phenomena and natural hazards: ocean observing provides crucial data which, together with computational modelling can produce near real-time weather and ocean forecasts and longer-term predictions to build a resilient society, particularly in coastal regions;
- Climate change: long-term ocean monitoring is crucial to help track, understand and forecast human impacts and to observe climate change impacts;
- Enhancing basic knowledge of the ocean/its role in the Earth system: once collected, ocean observations can be used for multiple purposes including scientific research driving new understanding and innovation;
- Ocean literacy: ocean observations are key to demonstrate the value of the ocean services, both economic and ecosystem to the general public. Citizens can engage through citizen science, contributing to both data collection and increasing public awareness.

EOOS will put mechanisms in place so that users and data providers are part of EOOS co-design and societal drivers, needs and requirements feed into the framework's development.

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<sup>13</sup> <http://www.un.org/depts/los/biodiversity/prepcom.htm>

<sup>14</sup> <http://ipcc.ch/>

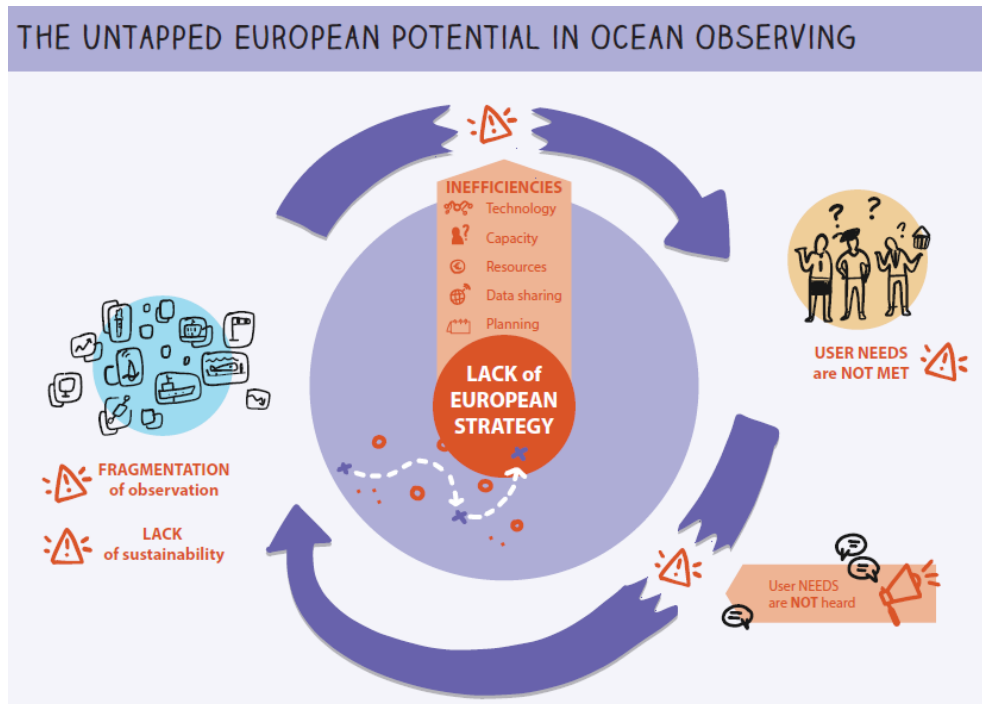
<sup>15</sup> <https://www.ipbes.net/>

<sup>16</sup> <http://www.worldoceanassessment.org/>

<sup>17</sup> <http://www.oecd.org/environment/the-ocean-economy-in-2030-9789264251724-en.htm>

<sup>18</sup> <https://www.gov.uk/government/publications/future-of-the-sea--2>

a)



b)



Figure 1: a) The existing challenges and untapped potential of fragmented dispersed ocean observing efforts, and b) The added value of a coordinated European Ocean Observing System framework

## What does European ocean observing look like now?

Europe's capability in ocean observing and marine monitoring is large and widespread. From operational oceanography to research-driven observing platforms, and from policy driven environmental monitoring of European waters for assessments, e.g. MSFD, to industry-driven coastal and offshore monitoring for marine and maritime economic activities, the stakeholder communities and observing infrastructures are diverse and span all marine environments.

European nations have made significant investments in National public ocean observation infrastructure and to operationalize oceanography through European Global Ocean Observing System, EuroGOOS, Mediterranean Operational Network for the Global Ocean Observing System, MONGOOS, and other Global Ocean Observing System, GOOS, Global Regional Alliances (GRAs). The European Union continues to support Research Infrastructures from many marine domains including Research Vessels, Argo floats, European Marine Seas Observatory (EMSO) and European Marine Biological Resource Centre (EMBRC), and funds projects to progress research, innovation and coordination across the topics of ocean observation, technology, data management and service provision. However, most of these initiatives are funded in the short to mid-term, not beyond. In addition, existing projects and initiatives are often limited by their scope, geography and/or a particular community. This lack of connection across marine and maritime data collectors and users leads to a fragmented system. Regional Sea Conventions are an important longer-term framework for basin-scale coordination of marine environmental monitoring and observations which contribute to reporting for legal obligations such as MSFD and the European Environment Agency has a role in *in situ* earth observation coordination. However, there is currently no single framework connecting the full diversity of European ocean observation and monitoring, its stakeholders, capabilities, and services (EOOS, 2016<sup>5</sup>; EMB, 2013<sup>19</sup>). This is a missed opportunity for developing a shared strategy with a regular implementation cycle and evaluation process to engage stakeholders, promote sharing of best practices and, ultimately connect all existing ocean observing efforts to release the untapped potential in Europe (see Figure 1).

## EOOS: an opportunity for European society?

By strengthening coordination and co-operation, EOOS will help to leverage the best value from Europe's ocean observing capability, enabling a single monitoring effort to serve many needs. EOOS will provide a regular implementation cycle that will engage stakeholders and deliver a fit-for-purpose, sustained ocean observing system that better serves user needs and wider societal requirements.

This is crucial since the demand for seas and ocean data is growing, particularly for biological and biodiversity datasets. It is recognized that some sustained monitoring programmes already exist, for instance, for selected national and regional monitoring to assess the state of the marine environments, and operational oceanography e.g. for weather forecasting, climate monitoring and the blue economy e.g. maritime shipping. However, there are many other observing programmes that do not have sustained funding or are not linked to wider networks, for example with a regional sea.

In addition, given the strong impetus for growth in the maritime economy ("blue growth") ranging from tourism and aquaculture to renewable energy and shipping, there is an urgent need to improve our knowledge in all components of seas and ocean: physical, chemical, geological and biological for which

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<sup>19</sup> <http://www.marineboard.eu/file/18/download?token=QescBTo6>

sustained and, in some cases, continuous *in situ* data is lacking. A consolidated European outlook is crucial to address sustainability of *in situ* ocean observation data collection. For publicly-funded ocean observing infrastructure, national investment covers the majority of the full costs, with the rest being supported by short-term research projects at national, regional or pan-European level. However, many projects are funded over a short term, without an opportunity to transfer their legacy efficiently. Certain private sector ocean observing infrastructures are well-funded in the long term but opportunities to share infrastructure and data are underexploited, leading to redundancies in the observing system.

Technological advancements in ocean data collection are also driving a new era of information-rich datasets where increases in the amount, size and frequency is leading to a data deluge. EOOS can offer the step-change in ocean observation coordination that is required to realize the potential of virtual research environments being developed by the European Open Science Cloud<sup>20</sup> and pilot Blue Cloud that will drive open access to ocean data, metadata and computational power for society. In addition, Europe is also engaged in international observing programmes that plan major upgrades to support GCOS<sup>21</sup> and wider Sustainable Development Goals (SDGs) implementation and contribute to infrastructures such as ARGO (Deep Argo and BGC Argo future programmes) for which Europe will have to further contribute.

EOOS will align and coordinate the ocean observation community and highlight opportunities for synergy and cost reduction whilst maximizing benefits.

## EOOS Guiding Principles

At its core, EOOS is about maximizing the value and benefit of European ocean observation, producing knowledge, goods and services to serve society. To achieve this, EOOS follows 6 guiding principles for its coordination efforts by being:

- **Efficient** and fit-for-purpose as an integral part of the global ocean and wider earth observation system. EOOS will help deliver data, data products and knowledge through ocean, weather and climate forecasting, to marine and maritime stakeholders supporting sustainable blue economy, and international assessments;
- **Connecting communities**, coordinating efforts and engaging diverse stakeholders across ocean observing implementers, funders, and users from public and private sector research, operational oceanography, industry, and public authorities;
- **Inclusive**, representing all communities and promoting community-driven principles of open data, open science and Responsible Research and Innovation (RRI);
- **Innovative and adaptable**, adopting the Essential Ocean variables (EOVs) and Essential Biodiversity Variables (EBVs) as part of a wider network of societally-relevant time-series for climate, operational oceanographic and wider ocean health, including main pressures on the marine environment, such as litter, contaminants, physical disturbance and noise;
- **Stakeholder-driven**, set in the context of regular status reviews and bringing in the latest advancements in ocean observation and technology, through horizon scanning for future developments and opportunities;

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<sup>20</sup> <http://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud>

<sup>21</sup> <https://public.wmo.int/en/programmes/global-climate-observing-system>



- **Sustainable**, helping secure long-term financial investment from multiple stakeholders towards sustained ocean observation infrastructures supporting better sustainable management of the ocean.

## Main focal areas

### Better Coordinated and Sustained *In Situ* Ocean Observing

- EOOS will connect all stakeholders across the ocean observing community: this includes *in situ* observations and remote sensing (e.g. air-borne) and modelling.
- EOOS will maximize the value and benefit of European ocean observing, facilitating the production of knowledge, goods and services to serve society. This will be achieved in close association with the ocean modelling and satellite observation communities to ensure full integration and responding to user needs.

### Ocean Variables Relevant to Society

EOOS will serve as a European focal point for systematic, long-term observation and monitoring. It will be a platform to discuss, coordinate and implement:

- The international Essential Ocean Variables (EOVs) and marine Essential Biodiversity Variables (EBVs);
- Define priorities for wider ocean variables and parameters in Europe, from biology to hydrography, used for environmental monitoring assessments, industry and wider stakeholder purposes;
- EOOS will connect stakeholders measuring a range of additional parameters that have societal relevance; and
- EOOS will provide a framework for stakeholders to communicate and co-design an innovative, adaptable ocean observing system that can respond to new needs, apply emerging technology and invest in observations and big data challenges.

### Integrated Ecosystem Approach

EOOS will enable a new era of European ocean observing that has the Integrated Ecosystem Approach at its core. EOOS will help transformation from platform-specific observing to multi-platform, integrated and thematic observing – crucial to assess ecosystem health and functioning.

### Who are EOOS Stakeholders?

EOOS stakeholders are the multiple organizations operating and maintaining ocean observation and monitoring infrastructures. These include National oceanographic institutes, Research Infrastructure legal entities e.g. ESFRI organizations that manage and analyze ocean observation data collections, and the users of the ocean data, products and services. EOOS will enhance coordination, dialogue and strategy across all these communities.

EOOS will also help promote an interface for funders (at national, regional and European levels) to meet, exchange and develop a common understanding of the full European capability and the benefits of cooperation. This will allow funders and users to critically assess the real gaps in the system – as identified

by the ocean observing community – leading to greater strategy, planning and ultimately economic efficiency and increased cost-benefit and societal impact.

### What is the EOOS Added Value?

By 2022 EOOS will add value to existing initiatives and approaches, promoting greater alignment and coordination both with existing partnerships and identifying new connections. Table 1 outlines some examples of the state-of-play, current challenges and issues and how EOOS could add value.

The coordination and support activities for EOOS are summarized in Figure 2 and further detailed with concrete actions in the EOOS Implementation Plan 2018-2022. The costs for delivering the additional coordination activities are orders of magnitude lower than the system itself. For instance the international JCOMMOPS<sup>22</sup> provides coordination for a number of ocean observing platform networks at international level with an operational budget for 2016 costed at US\$667,000 per year (approx. 574,093 Euros per year).

### Stakeholder Engagement

EOOS will foster a dynamic European network of collaborative, connected stakeholders across multiple geographical scales from local to whole sea basin. The EOOS framework will be open and inclusive, based on the developing European Open Data<sup>23</sup> and Open Science<sup>24</sup> policies. Stakeholder interactions and dialogue will be ensured through regular events, joint actions and appropriate governance.

**Table 1.** European Ocean Observing System (EOOS): Examples of added value for Europe and worldwide.

State of Play	What’s the issue?	How can EOOS add value by 2022?
Europe has a loosely coordinated ocean observation capacity with no central focal point that represents the diverse communities and full capability (from operational oceanography to environmental monitoring, fisheries)	Ocean observation is undertaken at national level, at regional level (e.g. regional conventions), or at community level (e.g. operational oceanography). The lack of a single focal point for European ocean observing means that contributions to international agreements or agendas are not fully coordinated or representative of the full European capability. It would be a real asset both within Europe to deliver a wider diversity of high quality data and when Europe is called upon to deliver a European ocean contribution to international	EOOS will provide a focal point and coordination for the diverse ocean observations across Europe and will establish an appropriate interface for decision-makers. This will strengthen pan-European communication and will promote the diversity, standardization and accessibility and delivery of high quality ocean data at the appropriate temporal and spatial resolution for European policies and Directives e.g. MSFD, European initiatives e.g. European Open Science Cloud and the pilot Blue Cloud and as Europe’s contribution

<sup>22</sup> WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology in situ Observing Systems Support Centre [www.jcommops.org](http://www.jcommops.org)

<sup>23</sup> [http://ec.europa.eu/research/press/2016/pdf/opendata-infographic\\_072016.pdf](http://ec.europa.eu/research/press/2016/pdf/opendata-infographic_072016.pdf)

<sup>24</sup> <https://ec.europa.eu/research/openscience/index.cfm>

	agreements e.g. COP21 and UN2030.	to global initiatives e.g. COP21, UN 2030 Agenda and the 17 SDGs.
<b>State of Play</b>	<b>What's the issue?</b>	<b>How can EOOS add value by 2022?</b>
Data do not always meet user needs: despite the availability of relevant European ocean data, many are not used for environmental assessments (e.g. for MSFD) due to lack of data provenance, low quality control and accreditation.	Ocean observation data collection is often neither standardized nor quality controlled to an agreed level.	EOOS will provide a framework for data quality management, promoting best practice including a standard methodology, high-quality control and tracking data provenance. This will provide uniform data quality for use across research, industry, assessment and policy domains.  Strengthened coordination and stakeholder connection through EOOS can concretely assist countries to develop integrated surveys and observation/ monitoring programmes as a result of ecosystem-based directive requirements e.g. MSFD
Fisheries monitoring for industry regulation is ongoing in parallel with fisheries research; more could be done to share observation platforms and data and produce data products for users.	Fishing industry, environmental assessment monitoring, operational oceanography and marine research are not well connected, often acting as individual components and not collaborating.	EOOS will connect communities and help ensure fisheries and wider marine ecosystem data are available, platforms are optimized and agreed, and duplications reduced.
Copernicus operational ocean forecasting and climate projections lack the required high-quality data to support accurate forecasting of the ocean, particularly for biogeochemical forecast products. This is due to both data coverage and data availability and a need to optimize links with computational modelling.	Sustained and quality controlled <i>in situ</i> time series data are needed. Comprehensive sets of biogeochemical <i>in situ</i> data over the globe are lacking for biogeochemical and ecosystem modelling and CO2 monitoring. It is difficult to access harmonised coastal data (tide gauges, high-frequency radars, bathymetry, etc).	EOOS will help optimise the essential international <i>in situ</i> networks and define methods and techniques to enhance data availability from oceanographic and hydrographic platforms.
Real-time environmental monitoring and marine spatial planning are critical to the sea-based aquaculture sector, providing crucial information optimal production, welfare and aquatic animal health.	Due to lack of connection to the wider ocean observation and monitoring community, the aquaculture industry is not always aware of all available data, or latest products or services derived from ocean observation and monitoring data. In addition, users/decision makers have no clear focal point or	EOOS can deliver more coordinated, standardized and open access to: <ul style="list-style-type: none"> <li>• Real-time environmental monitoring data</li> <li>• Reliable tools and methods for integrated environmental monitoring</li> </ul>

	appropriate interface for ocean observing that spans operational oceanography, wider env. monitoring and connects to users. There is no joined up approach or strategic process	<ul style="list-style-type: none"> <li>New monitoring technologies (e.g. in situ instruments, sensors and satellites)</li> </ul>
<b>State of Play</b>	<b>What's the issue?</b>	<b>How can EOOS add value by 2022?</b>
The community lacks the ability to systematically measure many of the Essential Ocean Variables for Biology and Ecosystems proposed by the Global Ocean Observing System (GOOS) or those marine Essential Biodiversity Variables proposed by the Group on Earth Observation Biodiversity Observation Network (GEO BON) and other variables required	New technologies can increase observing capacity (typology and temporal-spatial scales) and reduce operational costs (e.g. RV time). EOOS needs to be capable of incorporating new technologies into the observing system as they progress sufficiently through the technology readiness levels.	EOOS will conduct regular mapping of ocean technologies  EOOS will initiate a technologies Forum to share data and methodologies and assess technology developments and readiness levels, connecting to users.
An effective, future-proof ocean observing system will need to include performance monitoring including metrics and indicators	There are no European standards for performance metrics or evaluation tools for ocean observations spanning operational oceanography and wider environmental monitoring. This makes comparing and evaluating observing system design and delivery across networks and systems difficult and leads to inefficiencies such as duplication of effort or sustaining part of the system that does not deliver.	EOOS could provide the data needed for a regular, holistic view of status of European marine ecosystems of high value for assessing good environmental status (e.g. for MSFD) and to support the blue economy. This should build upon existing efforts including working with existing international (e.g. JCOMM) and European organizations (e.g. EuroGOOS, EMODnet and Copernicus), Regional Sea Conventions and ICES. Key outputs could include developing European standards for key performance indicators, web monitoring tools, report cards to assess the status of the European Ocean Observing System.
Coordination is needed not only within the <i>in situ</i> network but between <i>in situ</i> and satellite-derived ocean observations, including marine and wider earth observations.	Currently, the links between in situ and satellite-derived ocean observations are not well developed. This is a missed opportunity to use the same data multiple times, not only for delivering information, products and services, but also for validation across observation collection programmes and infrastructures.	EOOS coordination can help connect the in situ and satellite ocean observation communities, including to wider earth system observation, to optimize and integrate <i>in situ</i> and satellite-derived ocean observation data to cross-validate and increase data quality.

EOOS will help stakeholders to align and integrate existing initiatives, ensure efficiency and value for money, and eliminate duplication by:

- Identifying common areas of interest, finding synergies, and complementarities;
- Engage actively with the users of ocean observations, products and services;
- Connecting and exchanging best practice in ocean observation operation and technology;
- Developing a data quality management framework to deliver high-quality data and track data provenance from collection through to products;
- Helping align financial and research/wider observation programming at national, regional and European levels;
- Identifying gaps in the in situ observing capacity from previous studies and new assessments, including links with remote sensing and modelling, and foster initiatives to fill those gaps;
- Conducting foresight and horizon scanning of the current and future scientific and technological developments;
- Driving capacity building for the evolving requirements;
- Identifying training needs and capacity building gaps across the EOOS value chain;
- Providing leadership for ocean observation;
- Influencing the future direction of the European ocean observing;
- Promoting ocean observing services for multiple sectors.

The EOOS Forum on 8 March 2018 provided a platform to connect stakeholders, exchange ideas and gather feedback on how EOOS should develop. The Forum is proposed as a regular event to stimulate dialogue amongst the ocean observing community as well as wider users and communities. This may be complimented with other event formats from webinars to conferences. Stakeholder engagement and communication strategy will be crucial for the EOOS implementation.

## **Governance**

EOOS is a coordination framework, not a member organization, with a federation of voluntary partners spanning the public and private sectors. EOOS will have a light governance structure that is flexible and adaptable, placing stakeholder dialogue and input at its core. EOOS will not take ownership or control of ocean observing in Europe but will help improve the existing efforts and capitalize on the benefits of cooperation. This will help enable strategic planning of European ocean observing, break down institutional barriers, and make ocean observing more efficient and effective at different geographical scales, and for different users.

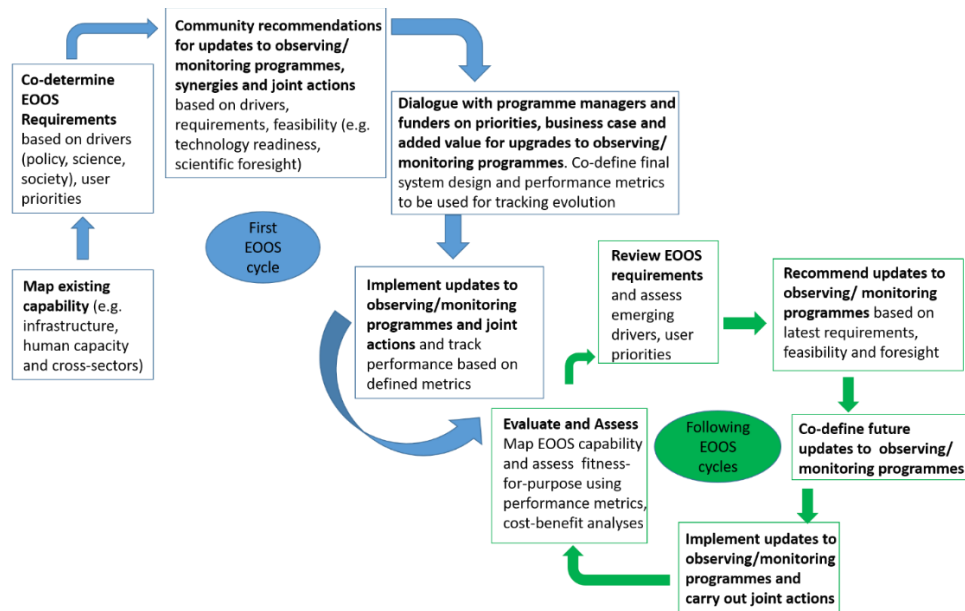
In its initial stages, EOOS coordination has been jointly led by the European Global Ocean Observing System, EuroGOOS, and European Marine Board. These two organizations co-chair the EOOS steering group set up in 2016 and involving several ocean observing experts, representatives of the European Commission, and JPI Oceans. An *ad hoc* Advisory Committee, established to advise on the stakeholder engagement and the EOOS events in 2018 includes representatives of the Regional Seas Conventions (e.g. OSPAR), and other organizations including ICES and representatives of wider ocean observing community e.g. biological marine stations.

EOOS governance will evolve over time to engage key Research Infrastructures, ensure representation from wider communities in environmental monitoring and connect to existing and emerging developments in ocean observation data management, post-processing, products and services.

EOOS governance will be implemented in a phased approach. This might include a more structured EOOS secretariat to conduct coordination activities such as the development of a business plan and the coordination and facilitation of an EOOS implementation cycle (see Figure 2), including regular cycles of stakeholder input for requirements setting, updates to the observing system and tracking of performance via metrics.

## Community Implementation

EOOS is a bottom-up, community-driven initiative. Successful implementation therefore depends on a joint, inclusive approach. An EOOS implementation plan for 2018-2022, details key EOOS focal areas for the coming five years and proposes actions with a clear time scale, objectives and milestones. The implementation cycle is summarized in Figure 2.



**Figure 2:** Key steps in the EOOS Implementation cycle showing the first cycle (blue boxes and arrows) and then following cycles (green boxes and arrows). Each cycle is proposed to last 5 years. Cross-cutting and intrinsic to each step in the EOOS cycle is stakeholder engagement, dialogue and co-design; Communication and societal engagement; and Governance and Coordination (see EOOS Implementation Plan for concrete actions)