



# A Roadmap for the Implementation of The Global Ocean Observing System 2030 Strategy

for an open planning process

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The GOOS number is: IOC/GOOS/240

## Foreword from GOOS

The demand for sustained ocean observations is increasing rapidly, and so are the requirements for ocean information. The Global Ocean Observing System 2030 Strategy provides the vehicle to meet expanding and urgent societal needs. The strategy is ambitious. It envisions a fully integrated global observing system ranging across the value chain that extends from observations, through data management systems, scientific analysis and forecast, to end users via information, data and decision-making services. GOOS will need strong partnership up to ensure the observing system delivers the information needed, and to build new advocates for sustainability.

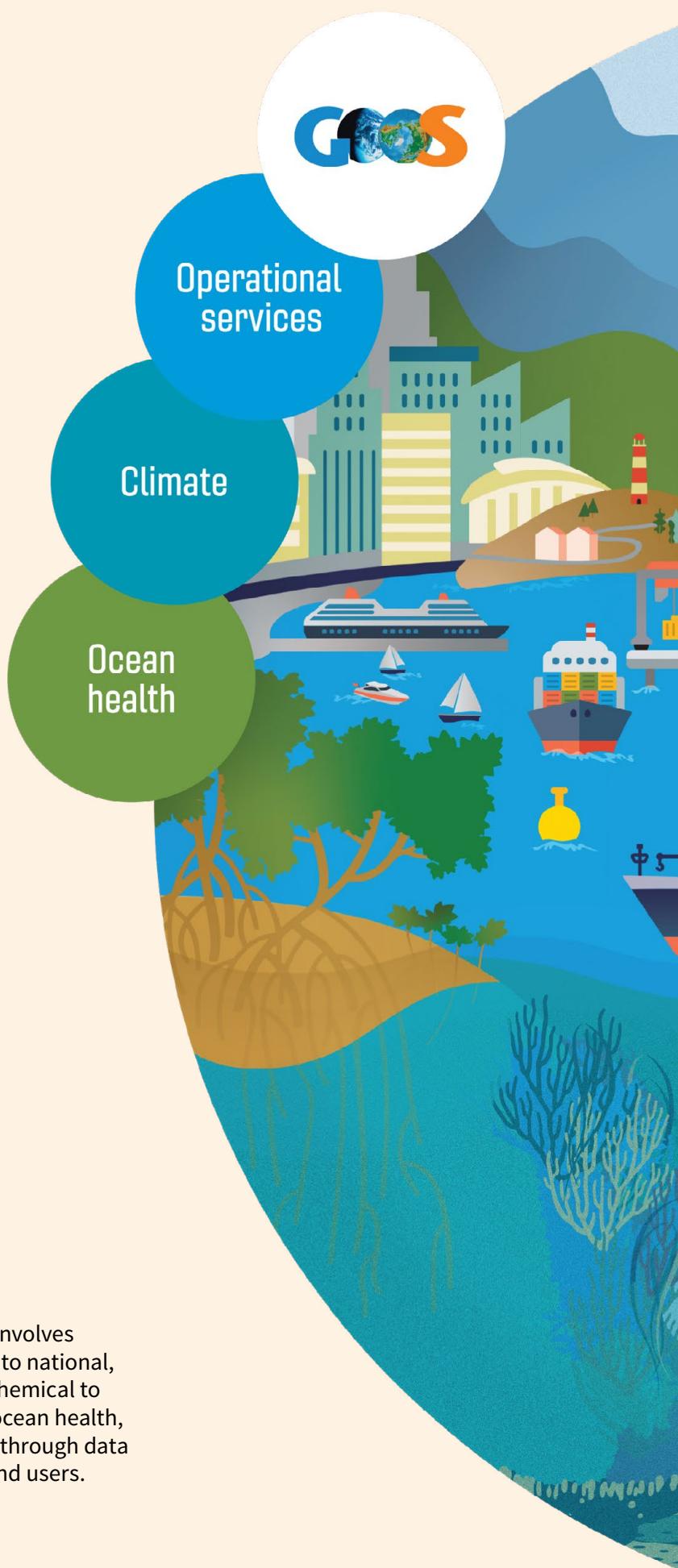
Under the 2030 Strategy, the eleven Strategic Objectives provide guidance on priorities for the development of a more user-focused and integrated system, and for the core work of GOOS itself. Objectives under the goal of “system integration and delivery” have historically been the core of GOOS, while the objectives related to “deepening engagement and impact”, and “building for the future,” will demand a step change in the level and effectiveness of partnerships across the value chain, from observations to end use and in areas outside GOOS core work, including technology, human impacts and capacity development.

This Roadmap is designed to provide a framework within which nations, partners and sponsors can envision actions towards achieving the 2030 Strategy. It will be a co-design process and we anticipate an evolving document focused on both the GOOS Programme and our partners’ actions. We also anticipate evolving the governance for an expanded observing system.

We hope that this Roadmap will help guide the priorities and the way forward for the global community. This document, and the actions it generates, will depend on your input. We strongly encourage you to provide feedback.

### Toste Tanhua

*Co-Chair, Global Ocean Observing System Steering Committee*



**Figure 1:** An integrated ocean observing system involves integration from open ocean to coast, from local to national, regional and global initiatives, from physical to chemical to biological realms, serving users from climate to ocean health, and integrated delivery chains from observation through data management and modelling to information for end users.



# 1. PURPOSE OF THE ROADMAP

## SCOPE

The *Global Ocean Observing System 2030 Strategy* identifies a vision for a **truly integrated global ocean observing system that delivers the essential information needed for our sustainable development, safety, wellbeing and prosperity.** Implementing this ambitious strategy will require broad partnership from science, industry, government and user communities, as well as a deep commitment to building human capacity and a strong multidisciplinary approach.

The *2030 Strategy* builds on the visionary *Framework for Ocean Observing*, strengthening the areas that have not yet been fully implemented, including partnership to support delivery of the essential information being sought by society, and broadening the delivery of the system to fully encompass the 3 core delivery areas.

This document is an initial Roadmap for the Implementation of the Global Ocean Observing System 2030 Strategy. It is a working document and intended to initiate a dialogue with partners across the observing system enterprise on how we can work together towards achieving this vision. It provides an open framework into which current and future partners can identify roles and areas in which working together will support the implementation and sustainability of a fully integrated ocean observing system.

The Roadmap adds substance to the eleven Strategic Objectives of the 2030 Strategy, laying out the issues, implementation ideas, and highlighting how they will act together to guide development of an integrated system. Some of the Strategic Objectives encompass core GOOS Programme activities, others will likely be led by partner organizations— **achieving the strategy will require cooperation, coordination and the commitment of many organizations and entities beyond the core of GOOS. It will also require a new system of governance.**

**Figure 2: Summary of Goals and Strategic Objectives**





## STRATEGIC OBJECTIVES

The Global Ocean Observing System 2030 Strategy defines 11 Strategic Objectives, under three overarching goals:

### Goal: Deepening Engagement and Impact

Deepen engagement and partnership from observations to end users to advance the use and impact of the observations and demonstrate its benefits.

SO1. Strengthen partnerships to improve delivery of forecasts, services, and scientific assessments.

SO2. Build advocacy and visibility with stakeholders through communicating with key users and national funders.

SO3. Regularly evaluate system impact to assess fit for purpose.

SO4. Strengthen knowledge and exchange around services and products, to boost local uptake.

### Goal: System Integration and Delivery

Deliver an integrated, ‘fit for purpose’ observing system built on the systems approach outlined in the Framework for Ocean Observing.

SO5. Provide authoritative guidance on integrated observing system design, synthesizing across evolving requirements and identifying gaps.

SO6. Sustain, strengthen and expand observing system implementation through GOOS and partner communities, promoting standards and best practice, and developing metrics to measure success.

SO7. Ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reusable, with appropriate quality and latency.

### Goal: Building for the Future

Building for the future through innovation, capacity development, and evolving good governance.

SO8. Support innovation in observing technologies and networks.

SO9. Develop capacity to ensure a broader range of beneficial stakeholders participation.

SO10. Extend systematic observations to understand human impacts on the ocean.

SO11. Champion effective governance for global in situ and satellite observing, together with partners and stakeholders.

## 2. CREATING IMPACT

To provide impetus for action, delivery and evaluation, we propose that the 2030 Strategy partnership work together towards achieving medium term (3-5 year) outcomes that will have impact and represent concrete steps towards the vision.

Below are some initial ideas as to what these targets for impact could look like. They are open for broad discussion and input, including from the synthesis of OceanObs'19 outcomes. Some could lay the foundation for programmes under the UN Decade of Ocean Science for Sustainable Development 2021-2030 ("Ocean Decade"). The aim is that they stretch across Strategic Objectives, and drive implementation with measurable impact towards an integrated system that delivers the essential information.

These draft proposed targets for impact are grouped under the 3 GOOS delivery areas:

### Climate

1. Designing global targets and beginning to implement ocean observations to track **carbon export** in the ocean, whose future projections have only medium confidence in IPCC assessments.
2. Developing ocean observing guidance to improve **response and adaptation scenarios for coastal communities facing sea level rise**, in partnership with coastal planners and engineers, and implement in a number of pilots.

### Operational Services

3. Improved **forecasting of high impact events: sea level extremes, tropical cyclones, extreme ENSO, and marine heat waves** through increased ocean observations, model improvement, and an earth system approach. Include evaluation of ocean

observation impact on end users. This could include a pilot for a responsive component of the ocean observing system to provide essential information ahead of a forecasted event.

4. Optimal design of the interface between open ocean and coastal observing systems to support **improved coastal forecasting**
5. A **connected, integrated and sustained ocean observing system under development around the African continent**, with initial structure and data flowing to support sustainable development of the marine economy.

### Ocean Health

6. Five '**global biological and ecological (BioEco) observing networks implemented** to at least the pilot stage (in all network attributes<sup>1</sup>), with three beyond pilot level.
7. **Improved delivery of indicators for conventions:** a step change in ocean observing capacity for the UN Sustainable Development Goals and Convention on Biodiversity targets.
8. Full implementation of three new **human pressure EOV observing systems**, such as marine litter, with coordinated observations and connection from observations to data users

<sup>1</sup> See the Observation Coordination Group (OCG) list of 'Attributes of a an OCG 'global' Observing Network, as a guide – on this link.



### 3. ROLE OF THE GOOS PROGRAMME

Since 1991, GOOS has created an extensive global system, based on contributions from a large number of organizations and nations, from which nations and people all over the world benefit. In its first decades, GOOS coordinated the development of a global ocean observing system designed to support climate science and to serve as the observational backbone for operational forecast systems. In 2012, this success, coupled with growing concerns about the health of oceans and demand for information products to help nations manage their ocean economies, sparked development of the visionary Framework for Ocean Observing, a prime outcome of the OceanObs'09 Conference.

GOOS has led the implementation of the framework by the ocean observing community, with the goal of serving users across climate, operational services and ocean health, increasingly with a focus on coastal areas and regional seas.

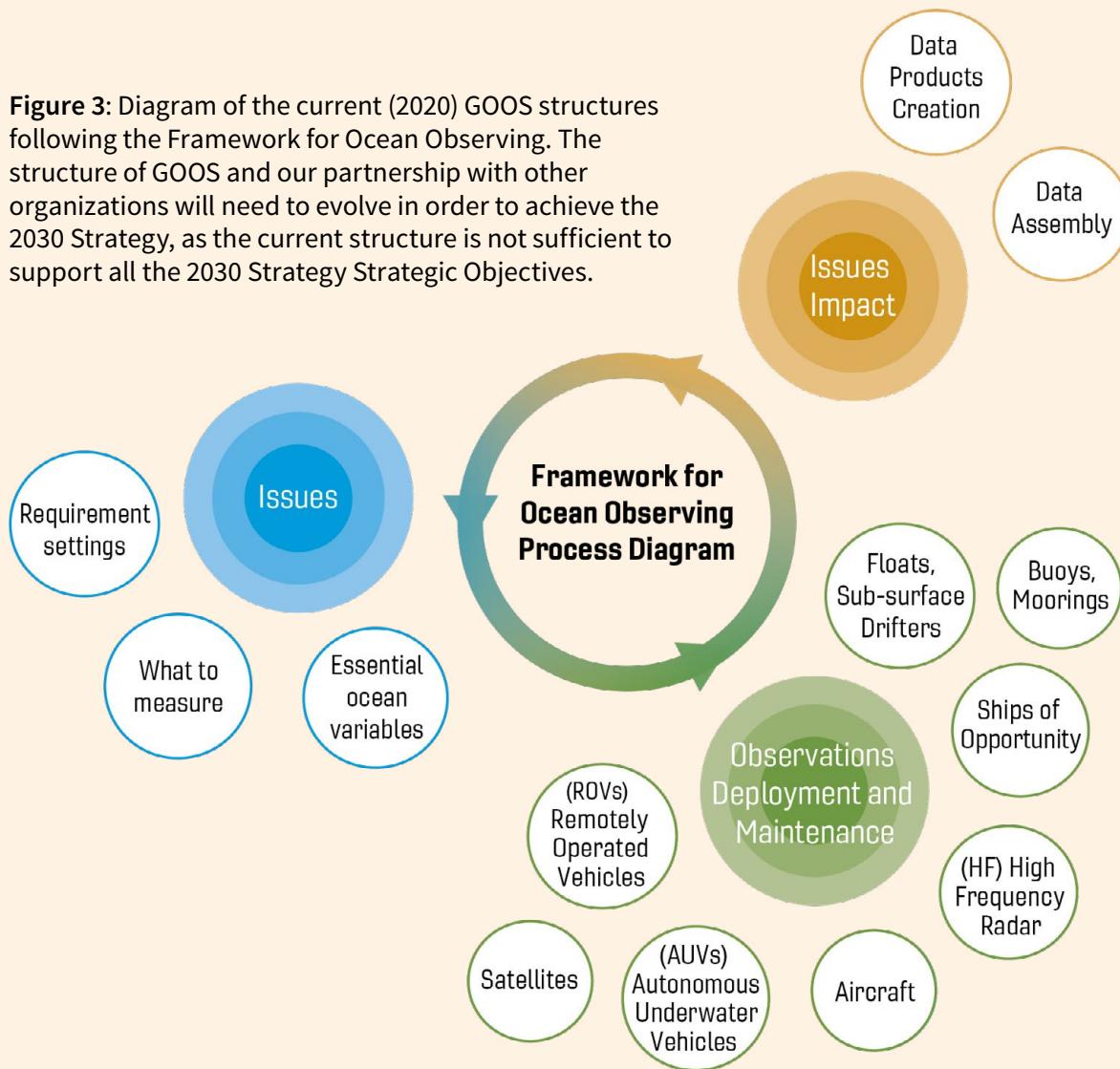
Today, GOOS has six key components:

- **Expert panels** for physics and climate, biogeochemistry, and biology and ecosystems, that synthesize across requirements and provide guidance on observing system design;
- **The Observations Coordination Group, JCOMMOPS, and GOOS Regional Alliances** that implement observing systems and ensure the flow of observations across the global networks and regional observing structures;
- An expert team on **operational ocean forecast systems** creating guidance to improve capacity, quality and interoperability of ocean forecast products
- **GOOS Projects** that advance innovation and expand into new areas and capabilities for the observing system; and

- Core coordination through the a central **GOOS Office** in Paris and distributed nodes supporting GOOS structures and engagement. In 2020 a G7-GOOS Coordination Centre will begin operation as a complement
- Governance through a **GOOS Steering Committee and sponsors** (the Intergovernmental Oceanographic Commission of UNESCO, the World Meteorological Organization, United Nations Environment Programme, and the International Science Council).

The governance of the full span of activities in this Roadmap, many of which will be in conjunction with or led by partners, will lead to an evolution of present arrangements governing GOOS.

**Figure 3:** Diagram of the current (2020) GOOS structures following the Framework for Ocean Observing. The structure of GOOS and our partnership with other organizations will need to evolve in order to achieve the 2030 Strategy, as the current structure is not sufficient to support all the 2030 Strategy Strategic Objectives.



GOOS core principles have been constant since 1998<sup>2</sup> and are upheld through the implementation of the Strategic Objectives:

- Implement through user-driven design;
- Maintain sustained observations;
- Ensure regular evaluation;
- Set global standards and best practices;
- Encourage open data sharing;
- Develop capacity

GOOS already plays an essential role in coordinating the world's distributed ocean observing systems. Together with the broad ocean observing community, we will continue to provide a pathway for the evolution of the integrated global system and in particular for

ensuring that it meets the needs of the diverse array of end-users. We will need help however to achieve the ambitious vision of the *2030 Strategy*. Achieving this ambitious vision cannot be the sole responsibility of the GOOS community. It requires the commitment of many other actors, in the private and public sectors, working at global and local scales, in the ocean and from space, coordinating and evolving together.

To meet the challenge of the *2030 Strategy*, GOOS will need additional resources to support the management of partnerships, to develop communications and to support an expanding ocean observing enterprise.

<sup>2</sup> GOOS Strategic Plan, 1998, GOOS-41, [goosocean.org/goos-41](http://goosocean.org/goos-41)

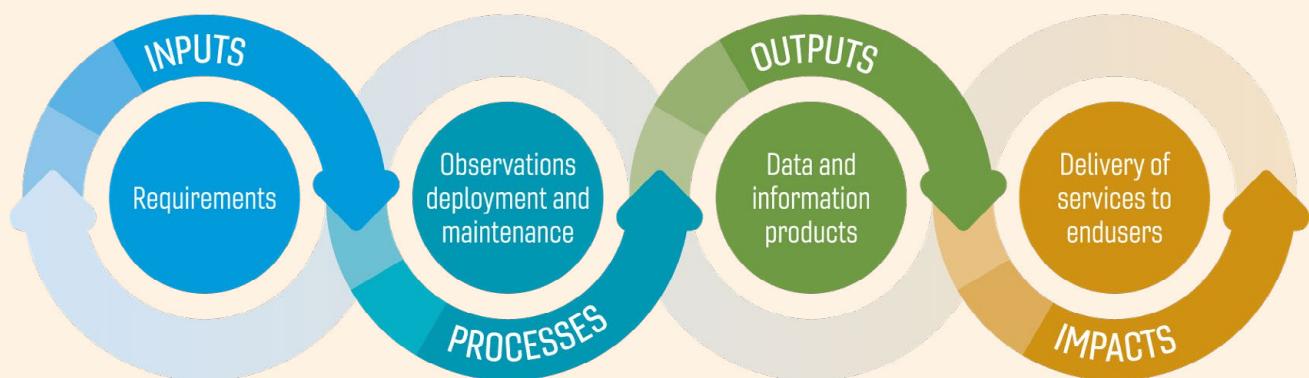
## 4. IMPLEMENTATION

The GOOS mission within the *2030 Strategy* is ‘To lead the ocean observing community and create the partnerships to grow an integrated, responsive and sustained observing system’.

GOOS is already working on implementing its mission. This *Roadmap* is a first step in the direction of engaging with partners and the observing community in general to achieve the vision of the *2030 Strategy*. In this section the Strategic Objectives are detailed to help conversation around partner roles and implementation. While this captures our thoughts, it is open to adaptation. We encourage partners to consider the strategic objectives and what role they would like to play in supporting or leading on these. Refined governance of the ocean observing system (Strategic Objective 11) will lead to improved cooperating, communicating learning and sharing processes that will support further evolution of this *Roadmap*.

The GOOS Programme is actively working on its implementation towards the same Strategic Objectives, and will note and integrate any adjustment suggested by a broader partnership as it develops.

**Figure 4:** Observations generate value for science or end users making decisions through a value chain, where each step add value to the basic observations. These run from observations through data management, analysis forecasts or models, services and applications, which provide information of value to end users in making short or long-term decisions of societal importance. Science is an important intermediate user, and research and innovation actions underpin the development of stronger value chains.





## STRATEGIC OBJECTIVES IN DETAIL

This section outlines the Strategic Objectives and is intended to provide an open framework in to support partners in implementing the 2030 Strategy.



## GOAL: DEEPENING ENGAGEMENT AND IMPACT

*Deepen engagement and partnership through the value chain from observations to end users, in order to advance the impact and use of the observations, and to improve visibility of the work of the observing system.*

*Meeting the four strategic objectives under this goal will require increased partnership along the value chain, and between observing communities at different scales, from local, to national, regional and global.*

*Under this goal are 4 strategic objectives.*

### SO1. Strengthen partnerships to improve delivery of forecasts, services, and scientific assessments

**Issue:** There is a fundamental lack of connection across the value chain, from observations to end use (see Figure 2), and therefore in our ability to implement end-to-end design and ensure fit for purpose delivery of information, and the ability for the system to be responsive to users through feedback loops.

**Implementation:** Building on a strong base of partnership with the global climate research community. GOOS and the community will work on building strengthened engagement with new and existing partners to improve the interface from ocean observing networks and data systems to key intermediate users across climate, operational services and marine ecosystem health applications and services. Establishing partnerships with key ‘super’ or ‘intermediary’ users (organizations that serve a broad range of end-users) supporting end-users in areas that have a high societal impact in order to enhance

the value chain from observations to end use. We also need to make a major leap forward in establishing partnerships to link sustained observations and scientific assessment for sustaining threatened ocean ecosystem services.

#### Outcomes:

- A strengthened, responsive and delivery-focused observing system;
- An increase in fit-for-purpose ocean information products (forecasts, indicators, coastal warning) based on sustained observations
- Ability to evaluate system for adequacy in meeting societal needs
- Improvement in the sustainability of the observing system individual components through visibility of how observational data contributes to critical services

#### Role of GOOS (to stimulate discussion)

GOOS will actively develop partnerships with key organizations to develop connection and feedback loops along the value chain, initially concentrating on data delivery to key intermediate service providers and areas that are high societal priorities

#### Potential partners (to stimulate discussion)

WMO is a key delivery partner for weather, maritime and climate services, the global modelling community is also a key partner across the delivery areas

## SO2. Build advocacy and visibility for the observing system with stakeholders, communicating with key users and national funders

**Issue:** The ocean observing system is predominantly funded through national investment, which is often fragmented across a variety of different funding sources, and dependent on successive short-term research projects. Knowledge of the economic value of the services it enables is scattered and not well defined. Major satellite and basin-scale in situ observing networks depend on funding from a very small number of countries. There is a fast growing need for: more nations to step up and support the system, for better understanding of the value of ocean observing and its contribution to sustainable economies, human health and safety, by politicians and the public. There is a need to advocate for long term thinking around funding mechanisms to support ocean observing.

**Implementation:** GOOS will work towards ensuring greater visibility for the vital work undertaken by the observing community and the value it provides, in particular targeting policy makers and funders. One component if this will be to gain a better understanding of the economic and socioeconomic value of ocean observations, through quantifying the impact of services at the end of the value chain. Through IOC, GOOS is in a unique position to be an advocate into international processes for sustaining essential observations, and to strengthen our vocal advocates within national agencies and organizations. We will seek to understand and reduce the risk to the sustainability of the observing system from dependency on large individual and short-term national contributions through all levers possible, including advocacy and capacity development. This is an area that all parts of the ocean observing enterprise can work towards, and GOOS can support by providing the community through provision of information, materials and a common voice to help make the

case at the appropriate funding levels. Nations in particular can support this effort through creating focal points within government for ocean related issues - ocean ambassadors or programmes. The partners in SO1 can strengthen the system through highlighting the role of observations and the value chain within their applications and services.

### **Outcomes:**

- Significant step-up in the external recognition of value of the global ocean observing system in climate, operational services, and marine ecosystem health areas
- An increase in longer-term sustained funding for ocean observations and a vocal community external to GOOS who are advocates for the need for this
- More nations participating in the observing system
- An observing system that meets national, regional and global needs
- Recognition for the role that GOOS, WMO and IOC play in supporting the global development of an ocean observing system

### **Role of GOOS (to stimulate discussion)**

GOOS to develop communications capability (requires expertise and resource), the GOOS Office to initiate and strengthen two-way communications with GOOS National Focal Points. An ongoing joint OECD-GOOS Project on the value of ocean observations, will provide needed insight for dialogue on the value of observations

### **Potential partners (to stimulate discussion)**

Nations investing in ocean observing, from large to small and with well-developed or developing capability, to provide feedback on priorities and communications needs. To be advocates for a fully integrated global system. IOC and Ocean Literacy activities are key

### SO3. Regularly evaluate the system to assess fitness-for-purpose

**Issue:** The Framework for Ocean Observing identifies the need for regular cycles of evaluation (Figure 2), at different levels: to ensure the data products coming out of the observing system meet the designed requirements, and to ensure that the information generated is having the impact on the societal issues that the system is designed for. At present, one framework for evaluation of global ocean observations for climate exists through the Global Climate Observing System and another through the World Meteorological Organization's Rolling Review of Requirements. However, we have little guidance to evaluate the observing system against other objectives, as a whole, or at regional and even local levels.

**Implementation:** Working through the Framework process and with value chain partners, GOOS and its partners will collaborate to undertake regular evaluations of how the observing system is delivering fit-for-purpose information for societal benefit areas and applications.

This assessment process will be guided by the requirements expressed against applications and knowledge challenges. The work GOOS has undertaken to develop the Essential Ocean Variables (EOVs), with scientific community input, forms a solid base and starting point for this effort. Leveraging the work in SO1 to develop partnership along the value chain, and work in SO2 on the value of ocean observations and the flow of data through national economies, and utilizing the independence of the GOOS Panels and projects, in-depth system design analyses can be developed. These can be focused on resolving knowledge gaps across the delivery areas that check fit-for-purpose of the delivery system as a whole.

Ultimately, we should aim to have a series of measurable metrics to evaluate the performance of the system towards delivering to a range of user needs, across climate, operational services and ocean health, and provide guidance on performing evaluations for regional, national, or local needs. These metrics should capture the status of components of the value chain, from observing networks, to data flow, models, and the impact of the data on policy, governance, and public arenas. We are some distance from having a comprehensive set of metrics and as this work is dependent on other strategic objectives, and so this objective will be implemented as SO1 develops. It is also anticipated that these evaluations and metrics will evolve, as GOOS projects and other innovation activities improve the capabilities of the system.

#### Outcomes:

- Operational tracking of the observing system against targets for climate, operational services, and marine ecosystem health
- Identification of gaps across the observing system (disciplines and domains) and at global, regional, and local scales
- A view of the status of the observing system to meet societal goals, including real-time view of status for short term response
- Guidance on how to evaluate observing systems from a regional and national perspective
- Increased efficiency in the application of resources to meet requirements
- Understanding of fall or drop in capability or observation quality and impact

### **Role of GOOS (to stimulate discussion)**

Developing metrics to monitor observing capacity and performance through the Observation Coordination Group and BioEco panel ‘global’ networks, with the support of JCOMMOPS. The initiation of basin and global views of observing capacity by EOV and ECV. Again, the joint OECD-GOOS project on the value of ocean observations may help in tracking where metrics can be applied.

### **Potential partners (to stimulate discussion)**

Partners in modelling, assessment, ‘intermediate’ or ‘super’ users could greatly aid through providing feedback on what is required from the observing system - variables, latency, precision, coverage, etc. - to improve services offered and the impact this would have on target user communities.

## **SO4. Strengthen knowledge and exchange around value creation from ocean observation, empowering the spread of end user applications at a local level**

**Issue:** Multiple national and regional investments have been made towards the development of products and services using ocean observations and forecasts. Although there are many successes, they are scattered across sectors, regions and stakeholders. Outside of weather forecast systems, there is no collective knowledge base regarding what ensures successful and value creating implementation of ocean data products and services.

**Implementation:** GOOS and the community can strengthen knowledge about the value of ocean data by employing external economic expertise to increase our understanding of the end-to-end value chain, from observation to end users. In order to help seed successful implementations

of ocean products and services, GOOS will seek to identify successful implementation, through GRAs, regional and national systems, and partners; understand the nature of this success; and share this knowledge of best practice within product and service development. Beyond this, growing partnerships between the observing system and commercial organizations will be a key component of broadening the availability and range of products and services available, based on ocean data and forecasts.

### **Outcomes:**

- Broader access and increased use of ocean data
- Increased innovation in ocean data services
- Building capacity and strengthening partnerships for delivery
- Improved decision making in the marine environment
- Enhanced impact for users of observing system at local/regional level

### **Role of GOOS (to stimulate discussion)**

The GOOS Office and Regional Alliances to work together in identifying successful products and services, that can be linked to capacity development and/or replicated in other regions.

### **Potential partners (to stimulate discussion)**

Partners in start-up incubation (particularly IT/information services), commercial companies providing services to the maritime industry, maritime industry associations and hubs, government business innovation initiatives and departments (particularly Blue Economy focused), to undertake or support the development of new services. GEO Blue Planet initiative has a focus on developing user interfaces and use cases for ocean data

## GOAL: SUPPORTING INTEGRATION & DELIVERY

*Deliver an integrated observing system that is fit for purpose and built on a systems approach as outlined in the Framework for Ocean Observing.*

*The three objectives under this Goal 2 are at the core of GOOS current activity, stronger partnerships, particularly in data management and expanding our observing capability will be required to develop a fully integrated system, as well as increased transparency of process to facilitate co-design and engagement.*

*This is the core of GOOS's current work, there are three strategic objectives under this goal.*

### SO5. Provide authoritative guidance on integrated observing system design, synthesizing across evolving requirements and identifying gaps

**Issue:** The requirements for the ocean observing system are expanding rapidly and exponentially, with users in different economic sectors requiring information at different levels of quality and latency. Creating individual observing systems focused on the needs of each delivery area is clearly not sustainable nor economic. An integrated global system needs guidance on design to maximize impact, balanced with the feasibility of implementing different options - both technical and for resourcing. The only clearly-stated global GOOS design responds to climate and is not yet fully integrated.

**Implementation:** GOOS will enhance its undertaking of multidisciplinary assessment and synthesis across a range of evolving requirements, in order to guide and support implementation decisions from global to regional, and across platforms, networks and technologies. This starts with an understanding of the needs for ocean information for public policy, government, citizen and private sector

decision-making, to respond to questions related to our understanding of the this complex whole earth system, and the information products and services that serve these applications. Requirements then are expressed against scientific or operational applications, the ocean phenomena, Essential Ocean Variables (EOVs) and Essential Climate Variables (ECVs), and time and space scales, that need to be sustainably observed to inform those applications defined; also taking into account the complementary design of satellite and in situ observing networks. Through cycles of assessment, defining requirements, providing implementation planning/guidance, and tracking, the design of the system is evolved. The process of triggering and supporting these reviews needs to evolve in the next years.

#### Outcomes:

- Refined designs for observing the essential global observations required for global issues that maximises return on investment
- A modular design approach to guide and support implementation decisions at regional and national level
- Greater efficiency in investment towards enhancing observing capacity
- Transparency in establishing and communicating on design requirements

#### Role of GOOS (to stimulate discussion)

Authoritative advice is expressed through the EOV Specification Sheets and Reviews from the GOOS Panels and Projects. The GOOS Panels are involved in horizon-scanning and dialogue with the community over emerging areas of need for coordinated and sustained observations, and the subsequent development of EOVs. The GOOS Projects have a key focus on improving system design around specific areas. This is a part of GOOS current core coordination activity.

### **Potential partners (to stimulate discussion)**

GCOS is a key GOOS partner for climate, with the IPCC WG1 and WG2, and the UNFCCC. WMO, and specifically WIGOS, are a key partner for delivery of operational services. The development increased partnership in the value chain will provide feedback on requirements from a user perspective and will strengthen the responsiveness of the system and its design to meet user requirements

### **SO6. Sustain, strengthen and expand observations coordination through GOOS and partner communities, promoting standards and best practice, and developing metrics to measure success**

**Issue:** The GOOS core system of ocean and marine meteorological observations is made up of many different observing platforms, sensors, techniques and communities. Together they have to respond to global, regional, and national requirements, and together deliver common data streams. Without coordination, opportunities for efficiency and knowledge-sharing between parts of GOOS are lost.

**Implementation:** This is a core activity for GOOS and covers many areas of GOOS activities. Other organizations also coordinate various forms of observing networks, such as those around fisheries, ocean acidification, and environmental monitoring. Some of these use the GOOS coordinated infrastructure, some initiate and coordinate their own; however all are clear potential partners for a fully integrated system and there is much to be gained from greater collaboration in enhancing delivery and efficiency. Satellite constellations for remote ocean observing are also an important component for a fully integrated system and again an important partner. Individual nations and regions investing in implementing are also key partners in this objective. GOOS will build on coordination activity in the JCOMM

Observation Coordination Group (OCG), GOOS Regional Alliances, GOOS Projects, emerging observing networks and national systems, as well as activity within IOC. GOOS will also reach out to allied areas in fisheries, biodiversity, and the satellite community to seek enhanced collaboration in observing and across the value chain. This coordination will include global tracking of observing system status, platforms for coordination of national activity at global and regional levels, the development and promotion of standards and best practices, tracking of data flow from platforms to data management systems, and the promotion of increasing readiness of new observing technologies and networks.

### **Outcomes:**

- Increased efficiency in use of resources
- More uses of data and more users served - enhanced delivery to end users across an integrated observing system
- A system for identifying and sharing of best practices and adoption of common approaches
- Increasing the number of observing networks, sensors and platforms with a Technology Readiness Level of 7 or more
- Coordination towards achieving common goals (reviews, synthesized requirements, etc.) across global, regional and national systems
- Expansion and evolution into new areas, identified through requirements and supporting emerging communities focused on solving global needs
- Increased interoperability of ocean data from variety of sources
- Support for sustainability through participation in a global integrated system

### **Role of GOOS (to stimulate discussion)**

The observing system implementation components of GOOS, the Observation Coordination Group, the Regional Alliances, the BioEco Panel networks are all actively working on this objective. This is a part of GOOS current core coordination activity. The Ocean Best Practice System a joint between IODE/GOOS Project is developing an innovative global system for the sharing of ocean best practices. GOOS Projects also support the development of future implementation components (e.g. DOOS). JCOMMOPS supports the flow, standardisation and quality of the metadata from the ‘global’ observing networks. Ongoing work with IOC, WMO, and the observing networks with regard to ocean observing system observations in EEZs

### **Potential partners (to stimulate discussion)**

Partners in the value chain can support the development of an ability to track data and metadata flow, latency, and delivery across an integrated system. Partners and GOOS can learn from sharing knowledge and best practices.

## **SO7. Ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reusable<sup>3</sup>, with appropriate quality and latency**

**Issue:** The ocean sustained data system architecture, from acquisition to dissemination, is incomplete and often fragmented. Some ocean data are incorporated into the meteorological WMO Information System for coupled ocean-atmosphere forecast systems, and the IOC and ocean community are developing the concept of an Ocean Data Information System. The cultural revolution of free and open data sharing that has been achieved for most platforms measuring open ocean physical variables frequently does not extend to biogeochemical and biological variables, and to some areas under national jurisdiction. In this fragmented landscape users can find it difficult to encounter the data

they need. To ensure a data system that is fit for purpose and FAIR (findable, accessible, interoperable, and reusable), there needs to be a clear connection from observations to users, through relevant data management systems, that can be refined via evaluation cycles to ensure that the data is of appropriate quality and latency.

**Implementation:** Building on GOOS principles and the IOC Oceanographic Data and Information Exchange policy, we will promote that ocean observations are made available to users on a free and unrestricted basis, ensuring full and open exchange of data, metadata and products at minimum time delay and need to be preserved and remain accessible indefinitely. With partners we will track the performance of the global in situ observing networks in relation to these principles, through the specified data assembly centers and track availability through the use of metrics. We will engage with the observing community and data aggregators to bring these data streams together, ensuring timely data submission and mechanisms to provide credit, relevant information on data provenance and processing (metadata), interoperability between data systems (including satellite), ensuring data availability for each EOV and relevant ECV.

This is an area in which GOOS seeks strong partnership across the data management landscape. We will support the flow of data by promoting the use of modern information and communication technology, and ensuring that data and associated metadata are discoverable, however it will take partnership to reduce fragmentation and ensure data flow is increasingly frictionless. GOOS will work with partners on all levels to encourage the adherence to the FAIR principles - findable, accessible, interoperable, and reusable - from observations to information products. Data flow will be brought into the evaluation cycle for end-to-end delivery, with an understanding of quality and latency appropriate for users, to ensure end-to-

<sup>3</sup> FAIR principles: Wilkinson et al., 2016

end responsiveness. The opportunity is large, sound and effective (frictionless) data flow is fundamental to delivery of a functioning system and achieving the vision and partnership is fundamental to achieving this objective.

#### **Outcome:**

- An identified and tracked global observing system data architecture as part of broader oceanographic, atmospheric, and earth system data architectures
- Data products based on EOV and ECVs available in a timely manner, with appropriate quality
- More data available, more appropriately, to more users
- Availability of meaningful data metrics

#### **Role of GOOS (to stimulate discussion)**

The GOOS observing components, the Observation Coordination Group, the ‘global’ observing networks, the GOOS Regional Alliances, the BioEco Panel EOV networks, and the GOOS Projects, all work towards FAIR data within each network and across all variables. In addition, JCOMMOPS (under the Observation Coordination Group) monitors and supports the flow of quality of the metadata from the ‘global’ observing networks, JCOMMOPS also supports work towards standardization of metadata across networks, appropriate metadata is vital for achieving FAIR data principles

#### **Potential partners (to stimulate discussion)**

IODE and WMO are key global partners for data management and delivery of ocean data, and to promote FAIR (findable, accessible, interoperable, and reusable) principals for ocean data. National and regional ocean data centers are also key partners for data management and delivery of ocean data, and to promote FAIR (findable, accessible, interoperable, and reusable) principals for ocean data.

## **GOAL: BUILDING FOR THE FUTURE**

*Building for the future with innovation, capacity development, and evolving good governance.*

*The strategic objectives in Goal 3 anticipate a heightened level of cooperation between partners in the observing system enterprise, and entraining new partners beyond those involved today. Meeting these objectives will also be about co-development, GOOS can play a leading role in some, such as SO11, however it is anticipated that partners will take the lead in others.*

*These strategic objectives encompass areas that are beyond GOOS current core activities, but that are identified as vital to achieve the 2030 vision, GOOS will require strong partnership to fulfill these objectives, possibly with partners leading the implementation.*

#### **SO8. Support innovation in observing technologies and networks**

**Issue:** Observing technology evolves rapidly, while a sustained observing system has to balance continuity and responsiveness to technological developments. Technological development takes place in research institutes and in commercial companies, and there is a need to connect promising developments to areas of high user need or impact.

**Implementation:** This is an area in which increased partnerships across the ocean research, commercial and operational communities are required to assess and improve the readiness levels and encouraging the speedy deployment of promising observation technology, platforms and techniques, including citizen science, to measure each EOV and relevant ECV. GOOS will seek to capture the observing innovation outcomes of the UN Decade of Ocean Science for Sustainable Development and GOOS Projects into the sustained observing system and support increased partnership for observing system technologies

### **Outcomes:**

- Faster adoption of new technology
- Increase scope, efficiency and observational capability
- Focused and faster technological development to meet new observing challenges

Certain contexts may require the development of observing tools and best practice guides adapted to local conditions for deployment and maintenance of observing networks, and the strengthening of local monitoring systems.

The engagement of countries that already have a strong marine science community can be achieved with the modest use of new resources that link existing GOOS global and regional structures. But, in order to have any lasting impact, developing the sustained ocean observing capacity of least developed countries and small island developing states has to be done in the context of broader end-to-end initiatives that are linked to development-targeted environmental processes, like the Sustainable Development Goals, climate adaptation, the Large Marine Ecosystem programmes, or Regional Seas Conventions.

Strong and broad partnership is vital and the needs of users considered, the capacity requirements across different regions can be strikingly varied.

### **Outcome:**

- a greater number of countries actively participating in the global ocean observing system and benefiting from information products;
- new best practices and data products addressing the needs and capacities of increasingly diverse participating countries

### **Role of GOOS (to stimulate discussion)**

Engagement with GOOS Regional Alliances and national ocean observing programmes, particularly with regard to identifying opportunities for skills transfer. Identifying opportunities to broaden and enhance the existing capacity development through the Observation Coordination Group working with the networks and the Ocean Best Practice System (joint GOOS-IODE project) to support training in best practices.

### **Role of GOOS (to stimulate discussion)**

The Observation Coordination Group is undertaking some work in this area, coordinating across ‘global’ networks to identify technological needs

### **Potential partners (to stimulate discussion)**

Partners in research organizations (including through POGO) and commercial organizations developing technology for ocean observing, open dialogues on priorities. National and other partners interested in supporting innovation

## **SO9. Develop capacity to ensure a broader range of beneficial**

**Issue:** There are profound gaps in our ocean observing coverage. This is not a matter simply of one-off investment, but of sustained capacity development in the infrastructure and techniques of observation, the design of responsive multi-platform observing systems to meet regional and national science and societal needs, and the use of this data to deliver societal benefit. Without this pull it is difficult to conceive of sustained new observing capacity, including meeting national reporting requirements under global agreements.

**Implementation:** GOOS will partner in a broader context of the IOC and other Programmes to implement actions that sustainably develop capacity in ocean observations, data systems, and other elements of the value chain to deliver local benefit. Development will focus both on human capacities, as well as the transfer of marine technology, including knowledge on observing techniques and best practices.

## Potential partners (to stimulate discussion)

Partners in initiatives that are linked to sustainable development associated with the marine environment. IODE is a key partner in the delivery of training through Ocean Teacher Global Academy and through the Ocean Best Practice System.

### SO10. Extend systematic observations to understand human impact on the ocean

**Issue:** A need to integrate the pressures from human activity with observation and modelling of climate and marine ecosystem health, combined with advances in observing system technology, strongly suggests that the time could be right to extend ocean observing capacity to monitor human impact variables.

**Implementation:** GOOS will seek partnership to develop knowledge of the requirements landscape around human impacts and to assess elements or variables that are suitable to support as EOVs, within an integrated global observing system. It is anticipated that this partnership could identify and implement pilots to assess the viability and value of this approach, considering delivery channels from observations to end users. Possible pilots could focus on ocean noise, marine plastics, and harmful algal blooms. Engagement with regional ocean assessment activities will be important to implementation and feedback on the relevance of global coordination.

#### Outcomes:

- A pilot project, in partnership with other organizations in this area, around variables related to human impacts, potential initial targets are ocean noise, marine plastics, and harmful algal blooms
- Recommendations for the implementation of new EOVS and the global monitoring of selected human impact variables within an integrated global ocean observing system

## Role of GOOS (to stimulate discussion)

The BioEco Panel has partnered to develop an Ocean Noise EOVS and the Biogeochemistry Panel is considering relevant support for the emerging and dispersed work in the marine plastics area.

### Potential partners (to stimulate discussion)

IOC programmes and UN Environment are important potential partners in this area. Partners in initiatives that are linked to sustainable development, pollution and other human impacts on the marine environment to initiate dialogue on how the global ocean observing system could support the measurement of needed variables or how knowledge gained in sustainable monitoring might be useful in other areas

### SO11. Play a leading role in establishing effective governance for global in situ and satellite observing, together with partners and stakeholders

**Issue:** As the global ocean observing system grows from a focus on serving climate science and policy, to serve a broader suite of users across operational services and ocean health, encompassing open ocean and coastal applications, the complexity of the “system” (as defined by the Framework for Ocean Observing) multiplies. We operate now with a historical accretion of organizations and networks, working on different parts of the value chain from observations to end users; at a global, regional, national and local levels; and focused on different segments of users and different EOVS and ECVs or issues.

The present governance arrangements are not sufficient to realize the ambition of the 2030 Strategy, as they do not optimally connect the different communities, networks, and partners in fully achieving their potential; and generally ignore private sector partnership. They do not allow for a full implementation of the concepts identified in the Framework for Ocean Observing.

An inclusive and global governance architecture is needed to enable direction setting, coordination, and the responsiveness of ocean observing within this complex landscape. This architecture needs to mesh with appropriate governance arrangements for the management of ocean-related risk, climate mitigation and adaptation, fisheries, pollution, and biodiversity issues.

**Implementation:** Building on engagement with stakeholders, key users, and funders, GOOS will foster a discussion with the ocean observing community on the characteristics of good governance, the potential systems and models for governance which can set global directions and design for an integrated observing system, that can respond to global and local issues. This will help to ensure global approaches that support local implementation of ocean observations.

Through dialogue with partners, we will help to develop a community consensus of a governance architecture designed ocean observing systems at the appropriate level (global, basin-scale, regional, national, and local). It also identifies the principles, institutions and processes of this governance system through a best practices and consensus-building approach, building on and connecting existing structures wherever possible, and building on existing knowledge and practice in good governance.

**Outcomes:**

- A governance architecture for the global ocean observing system, that integrates GOOS and partners in a framework, with clarity in roles and processes and a cycle of evaluation
- A clearly articulated voice for ocean observations, with multiple stakeholders contributing to define the message
- Improved global observing system delivery, responsiveness and sustainability
- National systems supported in their goals for ocean observing

**Role of GOOS (to stimulate discussion)**

GOOS, as a first step for dialogue, is hosting workshops on governance to feed into a broader community discussion at OceanObs'19, and discussions with its co-sponsors

**Potential partners (to stimulate discussion)**

All partners and co-sponsors are invited to engage in the dialogue regarding effective governance for a global ocean observing system. It is anticipated that some action in this area will be an outcome from OceanObs'19

## 5. NEXT STEPS

This *Roadmap for the Implementation of the Global Ocean Observing System 2030 Strategy* is a framework document for partners to identify and discuss their roles in achieving the vision of a ‘truly integrated global ocean observing system that delivers the essential information needed for our sustainable development, safety, wellbeing and prosperity’. We envision this document will evolve through partner and community dialogue and partners are encouraged to provide feedback on the Roadmap.

This Roadmap does not yet embrace all the input and momentum from the OceanObs’19 conference (including those captured in Community White Papers and as outcomes of conference breakout sessions). We foresee a second version in 2020, where the OceanObs’19 input is worked into opportunities and partner roles can be more clearly articulated.

In the coming months GOOS will work with partners in identifying roles and activities for this Roadmap, and on developing its own near-term implementation plan.

In summary:

1. Evolution of the current draft Roadmap with input from the community. This is a key opportunity to listen to the community on needs and priorities
2. A revised Roadmap in late 2020, with input from partners on roles and actions, and priorities identified during the OceanObs’19 process
3. Development in evolving the governance and coordinating capability for a truly global ocean observing system





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