



INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

INFORMATION DOCUMENT

**INITIAL GLOBAL OCEAN OBSERVING SYSTEM
IMPLEMENTATION PLAN**

Summary

This document is both an initial Global Ocean Observing System Implementation Plan to meet the aims of the GOOS 2030 Strategy ([IOC-XXX/2 Annex 4](#)) and the biennial GOOS workplan (2020–2021) for the consideration of the Assembly at its 30th session (Paris, 26 June–4 July 2019). The document has been prepared by the GOOS Steering Committee in accordance with its terms of reference (IOC Resolution XXVI-8, 2011).

This initial GOOS Implementation Plan follows the eleven Strategic Objectives of the GOOS 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.

This initial Implementation Plan is a framework document for GOOS programme components, and for current and potential partners to identify their role 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 dialogue and regular updates. It represents a new approach to GOOS planning that is more inclusive of broader input, based on the new Strategy.

Section 3 focuses on resourcing of the GOOS programme, which is distributed at UNESCO/IOC and at other co-sponsoring and partner organizations in anticipation of the JCOMM reform.

1. INTRODUCTION

SCOPE

The *Global Ocean Observing System 2030 Strategy* ([IOC-XXX/2 Annex 4](#)) 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.

This document is an initial Global Ocean Observing System Implementation Plan to meet the aims of the 2030 Strategy. It is a working document and intended initiate a dialogue with partners across the observing system enterprise as to how we can work together towards achieving this vision. It intends to provide an open framework into which partners can project their roles in working together.

The Plan follows 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.

The priorities for GOOS action are outlined below and we invite partners and potential partners to work with this as an initial starting point and practical first step - towards the development of a truly integrated global ocean observing system.

STRATEGIC OBJECTIVES

The Global Ocean Observing System 2030 Strategy defined the following 11 Strategic Objectives (SOs), 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.

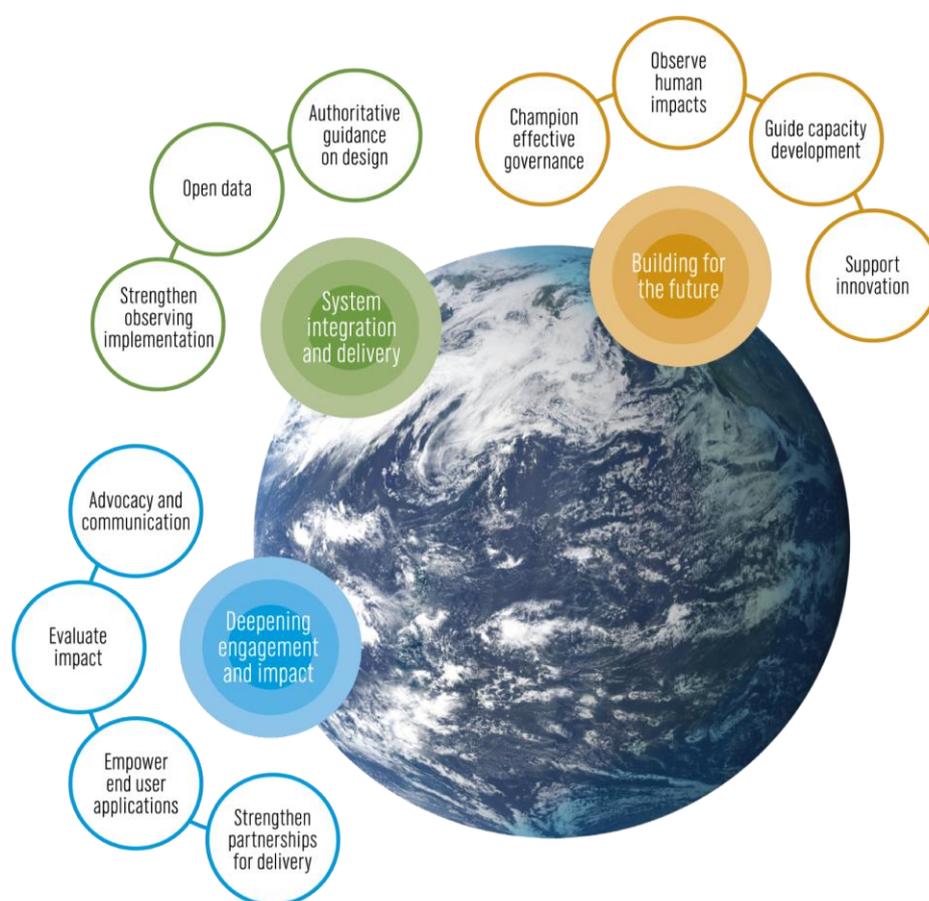


Figure 1. Summary of goals and Strategic Objectives

PRIORITIES: STRATEGIC OBJECTIVES

During the stakeholder review of the draft Global Ocean Observing System 2030 Strategy in mid-2018, contributors were asked to identify the most important Strategic Objectives. The GOOS Steering Committee Executive agreed to these as their 5 priority Strategic Objectives:

- SO1. Strengthen partnerships for delivery
- SO2. Advocacy and communication

- SO6. Strengthen observing implementation
- SO7. Open data (FAIR data)
- SO9. Guide capacity development

These five priority Strategic Objectives are the most developed in this initial Implementation Plan, along with GOOS current core GOOS activity areas:

- SO5. Authoritative guidance on design
- SO6. Strengthen observing implementation

In order to expand collaboration and partnership as this plan evolves, a broader governance for a truly integrated Global Ocean Observing System will also need to evolve. Thus SO11, Championing effective governance, is also an important focus for action.

PRIORITIES: MAJOR OUTCOMES

Working towards the eleven SOs will create a truly integrated system, however to provide impetus to that integration and to focus partner actions, GOOS proposes that the community work towards achieving several concrete outcomes in the first 3-5 years.

These outcomes provide specific focus areas for work that would bring together activities across several SOs to support system integration. These are also overarching aims that will considerably enhance our global ocean observing capacity and delivery.

An initial set of proposed outcomes, for broad discussion and adjustment, are:

1. Enhanced 7-day and seasonal forecasts (through increased ocean observations, model enhancement, and an earth system approach), with evaluation of ocean observation impact by weather forecasting and climate information systems
2. Adequately observe boundary currents globally, with data integrated into modelling and forecast systems, and products aimed at users including biological and ecological communities
3. All biological and ecological Essential Ocean Variable (EOV) observing networks are implemented to at least the pilot stage, with several beyond pilot level in all network attributes
4. Implementation of a connected, integrated and sustained ocean observing system around the African continent
5. A step increase in ocean observations and indicators in support of the UN Sustainable Development Goals - for 14 and beyond
6. Full implementation of three human pressure EOVs, with connection along the value chain, from observations to users
7. A pilot deep ocean observing system providing essential information for climate and ocean health

DEVELOPMENT OF THE IMPLEMENTATION PLAN

This Implementation Plan is a framework document for GOOS programme components, and current and potential partners to identify their role 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'.

Under each of the Strategic Objectives below there is an outline of: the issue being addressed, ideas for implementation, anticipated broad outcomes, interaction with other SOs and an indication of GOOS and partner roles, for discussion. Partners and components of GOOS are encouraged to provide feedback on these outlines and suggest activities towards achieving them.

We envision this document will evolve through partner dialogue, with a second version in 2020 where partner roles can be more clearly defined.

1. Initial phase through 2019 with input from partners and from the OceanObs'19 conference (16-21 September 2019, Honolulu, USA)
2. Version 2 of the Implementation Plan in 2020 defining partner roles and more specific 3-5 year actions towards achieving the major outcomes
3. Cycles of evaluation

2. IMPLEMENTATION FRAMEWORK

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.

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

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 can 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. As the first step in enhancing the value chain from observations to end use, an initial target will be 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. As an urgent priority, 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

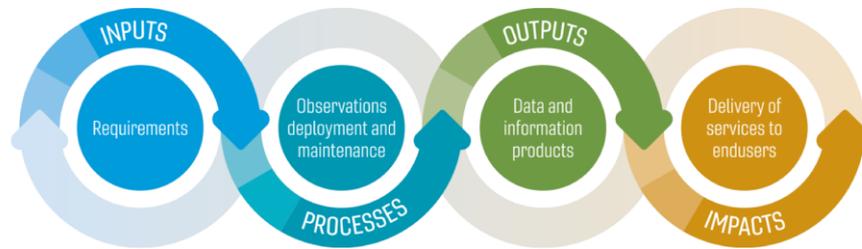


Figure 2. Observations generate value for science or end users making decisions through a value chain, where each steps add value to the basic observations. These run from observations through data management, analysis forecasts or models, services and applications, which provide information of value 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.

Connection with other SOs:

- SO6: Strengthen and expand observing system implementation
- SO7: Data Management

Role of components of GOOS (to stimulate discussion)

- Steering Committee and Exec members develop partnerships with key organizations

Role of partners (to stimulate discussion)

- WMO a key delivery partner
- IODE a key partner in the delivery chain
- Global modelling community as key partners across the delivery areas

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

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 of 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

Connection with other SOs:

- SO1: Partnership for Delivery
- SO6: Strengthen observing implementation
- SO9: Capacity Development

Role of components of GOOS (to stimulate discussion)

- GOOS Office to develop communications with GOOS focal points
- GOOS to develop communications capability (requires expertise and resource)
- Joint project with OECD on the value of ocean observations

Role of partners (to stimulate discussion)

- IOC and partner Ocean Literacy activities could be a key partner
- Nations investing in ocean observing, from large to small and with well-developed or developing capability, support targeted investment, provide feedback on services, indicate priorities, engage in governance



Figure 3. 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.

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 high level global mandates, and provide guidance on performing evaluations for regional, national, or local objectives. 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

Connection with other SOs:

- SO1: Partnership for Delivery
- SO2: Advocacy and communication
- SO5: Authoritative guidance

- SO6: Strengthen observing implementation

Role of components of GOOS (to stimulate discussion)

- GOOS observing networks (Observation Coordination Group and BioEco panel) developing metrics to monitor observing capacity and performance
- JCOMMOPS, with support of Observation Coordination Group, to initiate development of basin and global views of observing capacity by EOVS and ECV
- Joint project with OECD on the value of ocean observations

Role of partners (to stimulate discussion)

- Partners in modelling, assessment, 'intermediate' or 'super' users providing feedback on what is required from the observing system - variables, latency, precision, coverage, etc. - to improve services and the impact this would have on target user communities - cost/benefit

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

Connection with other SOs:

- SO1: Strengthen Partnership for delivery
- SO2: Advocacy and communication
- SO5: Authoritative guidance on design
- SO6: Strengthen observing implementation
- SO7. Open data (FAIR data)

Role of components of GOOS (to stimulate discussion)

- GOOS Office and GRAs to work together in identifying successful products and services
- Joint project with OECD on the value of ocean observations (SO2)

Role of 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.
- The GEO Blue Planet initiative has a focus on developing user interfaces and use cases for ocean data

GOAL 2: 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.

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

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

Connection with other SOs:

- SO1. Strengthen partnerships for delivery
- SO3: Evaluate for impact
- SO6. Strengthen observing implementation
- SO11:Championing effective governance

Role of components of GOOS (to stimulate discussion)

- This authoritative advice is expressed through the EOVS Specification Sheets and Reviews from the GOOS Panels and Projects
- 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
- Projects have a key focus on improving system design around specific areas

Role of partners (to stimulate discussion)

- GCOS a key partner, along with IPCC WG1 and WG2, and the UNFCCC, for climate
- WMO and WIGOS a key partner for delivery of services
- Partners in the value chain will need to provide feedback on requirements from a user perspective to strengthen the responsiveness of the system and its design to 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 - core activity & high priority

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

Connection with other SOs:

- SO1. Strengthen partnerships for delivery
- SO2: Advocacy and communication
- SO3: Evaluate for impact
- SO5: Authoritative guidance on design
- SO7: Open data (FAIR data)

- SO9: Guide capacity development
- SO11: Championing effective governance

Role of components of GOOS (to stimulate discussion)

- The observing system implementation components of GOOS are: the JCOMM Observation Coordination Group, the GOOS Regional Alliances, the GOOS BioEco Panel EOVS networks,
- The Ocean Best Practice System project (joint between IODE and GOOS) is developing an innovative global system for ocean best practices
- Projects support the development of future implementation components (e.g. DOOS) or these may be more fully integrated into the elements above
- JCOMMOPS (under the JCOMM Observation Coordination Group) supports the flow, standardisation and quality of the metadata from the 'global' observing networks
- Work with IOC, WMO, and the observing networks with regard to ocean observing system observations in EEZs

Role of 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 implementation components can learn from sharing knowledge and best practices

SO7. Ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reusable¹, with appropriate quality and latency - high priority

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 a 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 centres 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 EOVS and relevant ECV.

¹ FAIR principles: Wilkinson et al., 2016

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-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

Connection with other SOs:

- SO1: Partnership for Delivery
- SO3: Evaluate for impact
- SO4: Empower end user applications
- SO6: Strengthen and expand observing system implementation
- SO9: Guide capacity development

Role of components of GOOS (to stimulate discussion)

- The GOOS observing components, JCOMM Observation Coordination Group and the 'global' observing networks, GOOS Regional Alliances, GOOS BioEco Panel EOV networks, and the Projects, all work towards FAIR data within each network and component, and for all variables
- JCOMMOPS (under the JCOMM Observation Coordination Group) supports the flow, standardisation and quality of the metadata from the 'global' observing networks, appropriate metadata is vital for achieving FAIR data principles

Role of 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 centres 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 3: 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.

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 EOY 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

Connection with other SOs:

- SO1: Strengthen partnerships for delivery
- SO5: Authoritative guidance on design
- SO6: Strengthen observing implementation

Role of components of GOOS (to stimulate discussion)

- OCG coordinating across 'global' networks to identify technological needs

Role of 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 stakeholder participation - high priority

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. 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

Connection with other SOs:

- SO1: Strong partnership for delivery
- SO4: Empower end user applications
- SO6: Strengthen observing implementation

Role of components 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 JCOMM 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 partners (to stimulate discussion)

- Partners in initiatives that are linked to sustainable development associated with the marine environment
- IODE is a partner in the delivery of training through Ocean Teacher Global Academy

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 EOV and the global monitoring of selected human impact variables within an integrated global ocean observing system

Connection with other SOs:

- SO4: Empower end user applications
- SO5: Authoritative guidance on design
- SO6: Strengthen observing implementation
- SO7: Data Management
- SO8: Technology Development

Role of components of GOOS (to stimulate discussion)

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

Role of partners (to stimulate discussion)

- IOC programmes and UN Environment are important 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 - high priority

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 understanding of a governance architecture that is designed for decisions about ocean observations at the appropriate level (global, basin-scale, regional, national, and local), and 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. A polycentric multi-level approach is being considered.

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

Connection with other SOs:

- SO1: Strengthen partnerships for delivery
- SO2: Advocacy and Communication
- SO3: Evaluate for impact
- SO5: Authoritative guidance on design

- SO6: Strengthen observing implementation
- SO7: Open data (FAIR data)
- SO10: Observe human impacts

Role of components 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

Role of partners (to stimulate discussion)

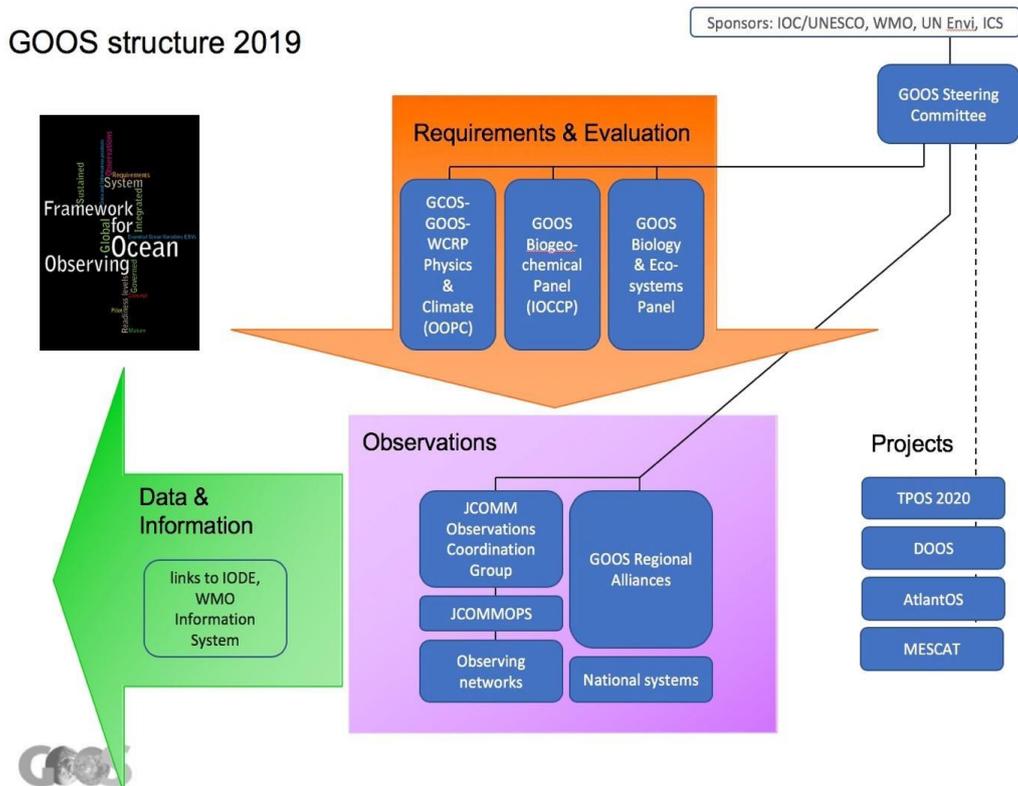
- All partners and co-sponsors engage in the dialogue regarding effective governance for a global ocean observing system
- It is anticipated that some action in this area will be an outcome from OceanObs'19

3. FOCUS ON THE GOOS PROGRAMME AND RESOURCING

The GOOS programme is co-sponsored by the Intergovernmental Oceanographic Commission of UNESCO, the World Meteorological Organization, United Nations Environment, and the International Science Council. This section focuses exclusively on the resourcing of the components of this programme, in contrast to the resourcing that we recognize is needed across a broad partnership of organizations to achieve an ambitious vision set out in the Strategy and in the rest of this Implementation Plan.

Today, the GOOS programme has four key components:

- expert panels for physics, biogeochemistry, and biology and ecosystems that synthesize across requirements and provide guidance on observing system design;
- the JCOMM Observations Coordination Group, JCOMMOPS, and the GOOS Regional Alliances that implement observing systems and ensure the flow of observations across the global networks and regional observing structures;
- GOOS Projects that advance innovation and expand into new areas for the observing system; and
- core coordination through the GOOS Steering Committee and a distributed GOOS Office.



Amongst the four co-sponsors at present, IOC provides the majority of regular programme resourcing (staff and activity funding) for the activities of the GOOS components, with WMO providing staff and activity funding to support the JCOMM Observations Coordination Group, anticipated to be incorporated into GOOS in the reform of JCOMM (see IOC-XXX Agenda item 5.1). This resourcing is complemented by substantive voluntary contributions by Member States directed at co-sponsors WMO and IOC, as well as substantive in kind contributions.

While *staff* funding comes from a mix of IOC Regular Programme, extrabudgetary, and in kind support, the majority of *activity* financing for GOOS components comes from the IOC Regular Programme Budget. For 2018-2019 this included:

- GOOS Work Plan \$165,000/yr
- JCOMM Observations \$40,000/yr
- JCOMM Services (operational forecast systems) \$32,500/yr

It is anticipated that for 2020-2021, with JCOMM observations and forecast systems work coming under the umbrella of GOOS, that this IOC regular programme resource base will remain relatively stable.

The distributed GOOS Office is headquartered at IOC/UNESCO, where a snapshot of staff resourcing in May 2019 shows 4.7 full-time-equivalent (FTE) staff distributed over seven people, working on overall strategy and steering, coordinating workplans across GOOS, providing core observations coordination, GOOS engagement with sponsors and partners, other intergovernmental processes, and contributing to specific funded projects. Nodes of the distributed GOOS Office, often working under multiple team management, are found at JCOMMOPS in Brest, France (anticipating again the reform of JCOMM); the Global Climate Observing System office at WMO in Geneva, Switzerland; the IOC Project Office for IODE in Ostend, Belgium; the SCOR-IOC International Ocean Carbon Coordination Project Office in

Sopot, Poland; and at the Australian Integrated Marine Observing System office in Hobart, Tasmania. In May 2019, these nodes had 7.3 FTEs contributing to GOOS, distributed over 9 people. These focus on support to the disciplinary expert panels, identifying GOOS requirements and design, providing a significant metadata service and technical coordination of observing networks at JCOMMOPS, and supporting projects that build the readiness for the next generation of GOOS.

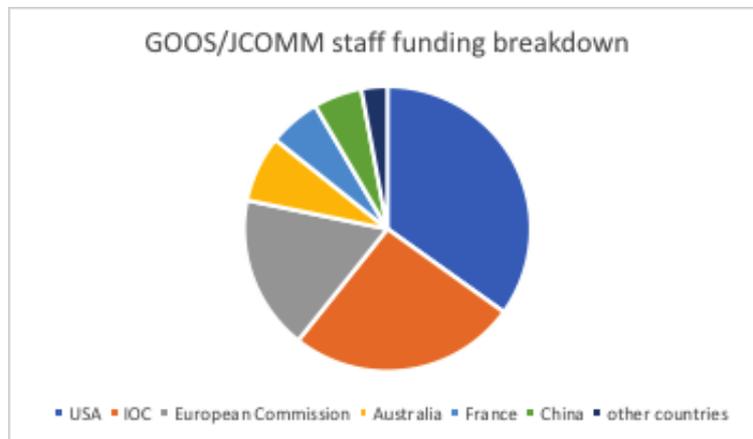


Figure 4. Overall funding providers for the staff FTEs in the distributed GOOS Office.

The distributed GOOS Office staff are funded by a mix of funding sources, including IOC regular programme and project funding, as well as voluntary and in kind contributions from Member States. A snapshot in May 2019, based on contribution towards FTEs, is shown in Figure 4. The funding support for this staff is in many cases fragile, as illustrated in Figure 5.

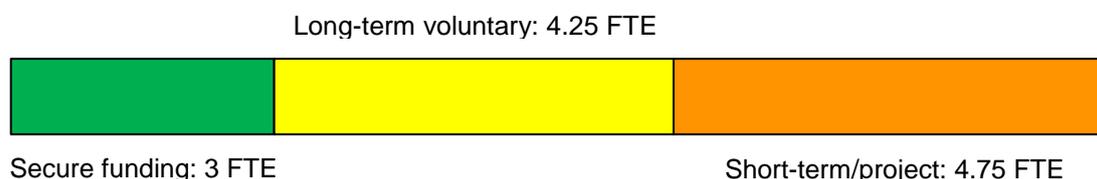


Figure 5. Fragility of funding for staff in the distributed GOOS Office: from secure (IOC Regular Programme funds), long-term voluntary (voluntary contributions from Member States with a long history of yearly contributions), and short-term or project funding with no medium-term security.

At present, the staff of the GOOS Office is in great majority focused on the Strategic Objective 6 *Implement and promote best practice* (Figure 6). This is a core historical and present objective of the GOOS programme, and therefore a natural and incompressible focus to sustain coordination activities. However, given the broad range of Strategic Objectives, and the priority on five objectives noted above, there is a need for additional effort towards the priority Strategic Objectives. These may come from the contributions of partners towards this Implementation Plan, but additional voluntary or in kind contributions will be needed to help the GOOS programme in its specific contribution to this Implementation Plan.

Additional resources provided on a voluntary or in kind basis by Member States to GOOS have the potential to contribute to the priorities identified in this strategy, and in particular to:

- substantially improve advocacy and visibility for the observing system with stakeholders (SO2)

- engage with national observing systems through GOOS National Contact Points and respond to their needs (SO2)
- develop stronger partnerships for delivery in each area: operational services, climate, and ocean health; as well as feedback into the observing system (SO1)
- convene partners and stakeholders and start to build stronger coordination, learning and sharing mechanisms (SO11)
- improve capacity development contributions of GOOS, both human and institutional (SO9)
- provide greater assistance to developing observing networks (SO6).

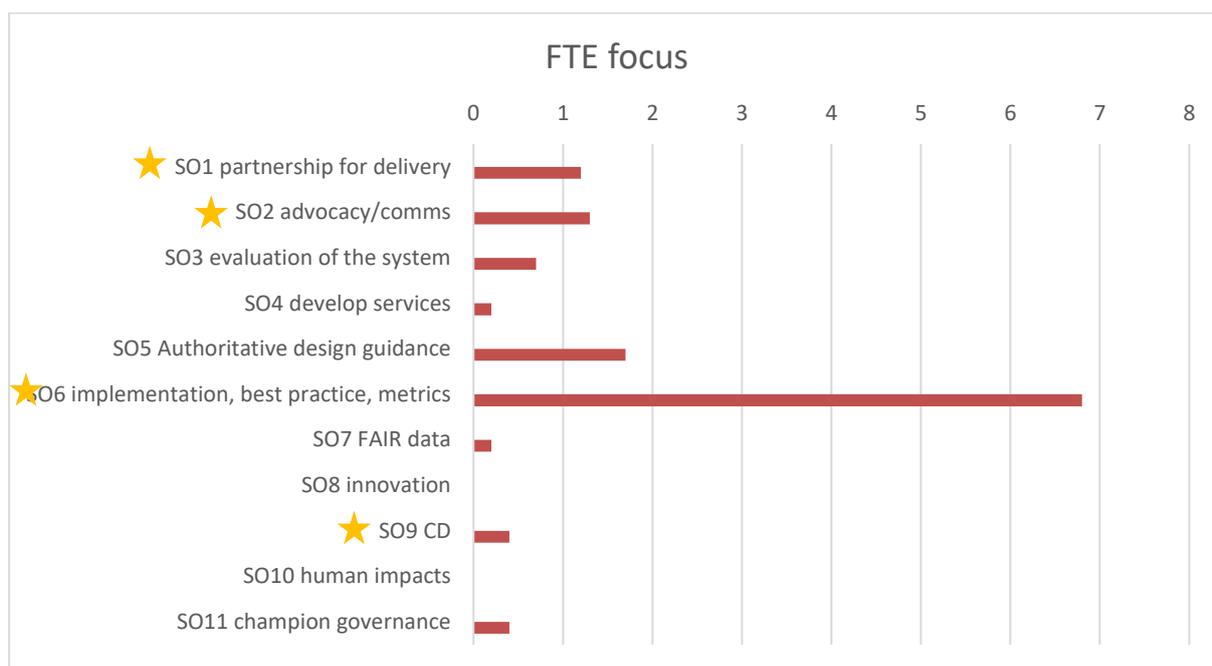


Figure 6. A snapshot (May 2019) of how staff in the distributed GOOS Office focus their effort by Strategic Objective.

Without additional resources, there is a substantial risk that the GOOS programme will not be able to contribute to a number of priority Strategic Objectives that have been identified, nor play the convening role required to fully develop the partnerships needed to achieve the ambitious *Global Ocean Observing System 2030 Strategy*.

A number of good prospects for increasing support for the GOOS programme have been identified, and these include:

- increased co-sponsorship and the creation of a node of the distributed GOOS Office at WMO, in the context of the reform of the WMO and the disbandment of JCOMM,
- European Commission funding of the Horizon 2020 EuroSEAS project, with IOC/UNESCO as a partner, and
- development of a G7-GOOS coordination office.

We welcome further expressions of interest of contribution from partners and Member States.