# Global Ocean Observing System 2030 Strategy

The Global Ocean Observing System

# OUR VISION

## A sustained global ocean observing system, spanning the physical to biological realms, from coasts to open ocean, serving governments, communities and industry by delivering the essential information to improve our safety, sustainability, wellbeing and prosperity.

People benefit from the ocean for food, tourism, and making a living. Our planet benefits from the ocean as a regulator of global climate.

Ocean knowledge and information have the power to unlock solutions, generating profit and jobs in the marine economy, protecting ocean ecosystems, and managing risk from coastal hazards and climate change.

That knowledge and information are built on models, forecasts and scientific knowledge of the ocean. These in turn must be built on a foundation of sustained monitoring of the ocean, its physical, chemical and biological character, and our human influence upon it.

A systematic approach to ocean observations identifies the essential information for many end users, and provides it in a sustained way—combining many pieces into a sum greater than its parts.

Building on an system that delivers global physical and some chemical ocean observations for climate challenges, and provides operational services for risk management in some regions, we envision a system in 2030 with greatly expanded geographical and thematic coverage, delivering a wide variety of essential information to end users.

# OUR MISSION

The Global Ocean Observing System (GOOS) exists as a hub of cooperation and a platform for many players to coordinate their activities, multiplying individual actions in a systematic way. These players include governments, UN agencies, networks of satellite and in situ implementers, academic institutions, and navies - working on observing tools and technology, data and information systems, forecasts, scientific analysis, services for end users and information tools for policy.

Coordinating action leverages each individual investment, adding to a larger system, and generating greater benefits. Sharing good practices and innovation allows each individual piece of the observing system to do its job better. Keeping a focused eye and building partnerships for delivery to end users ensures an efficient and fit for purpose system, maximizing value for investment. Advocacy ensures support for the system and increases the benefit through increased awareness and capacity to use ocean information.

GOOS is aimed at delivery in three areas: climate, operational services, and marine ecosystem health. Ocean information is central to both the global issue of greenhouse gas mitigation, as well as to the fundamentally local issue of adaptation to climate change. Operational ocean information services, such as forecasts and early warnings, can generate benefit for individuals, industry, and governments as they seek to grow the marine economy and manage risk from ocean-related hazards. And the sustainability of marine ecosystem health is tightly linked to knowledge that can only be generated and verified with monitoring of essential ocean variables.

**Lead the ocean observing community in growing an integrated and sustained global observing system focused on enhancing scientific knowledge and delivering essential ocean information to end users.**

# OUR STRATEGIC OBJECTIVES

GOOS will work with a broad ocean observing community and partners with three broad objectives: to build engagement and ensure high impact of observations, to enhance and evaluate the observing system design to meet user requirements, and to build for the future with innovation, capacity development, and good governance. In this Strategy, these are captured in eight Strategic Objectives, detailed later in the document.

| | |
|---|---|
| VISION | A sustained global ocean observing system, spanning from coasts to open ocean, serving governments, communities and industry by delivering the essential information to improve our safety, sustainability, wellbeing and prosperity. |
| MISSION | Lead the ocean observing community in growing an integrated and sustained global observing system focussed on enhancing scientific knowledge and delivering essential ocean information to end users. |
| FOR | Climate ~ Operational Services ~ Marine Ecosystem Health |

| **Engagement and Impact** | | |
|---|---|---|
| 1. Strengthen partnerships, to improve delivery to end users from observations through forecasts, operational services, and scientific assessments. | 2. Building advocacy and visibility for the sustained observing system with stakeholders,including key users and national funders. | 3. Provide authorative guidance to support implementation decisions on integrated observing at global, regional and national levels; synthesizing across a range of evolving requirements. |
| **Enhancement** | | |
| 4. Sustain, strengthen and expand observations coordination through GOOS and partner communities; supporting innovation in observing technologies and networks. | 5. Ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reuseable - the FAIR principles; with appropriate quality and latency for multiple end users. | 6. Develop capacity to ensure broader participation in and benefit from GOOS. |
| **Building for the Future** | | |
| 7. Develop metrics and regularly evaluate the ocean observing system to assess fitness-for-purpose as the system evolves to meet user requirements. | 8. Play a leading role in establishing effective governance for global in situ and satellite observing over the next decade, together with partners and stakeholers. | |

# INRODUCTION

## *THE CHALLENGE AND THE URGENCY*

The ocean affects all of us in so many ways. It covers 70% of the Earth's surface, and is the natural system that ultimately provides most of the air we breathe and the fresh water we drink. The ocean is the primary controller of the global climate that makes this planet habitable for humankind.

The ocean is also the pathway for 90% of global trade, provides 17% of the animal protein consumed by the world's human population, is a huge draw globally for tourism, and hosts 99% of the habitable space for our planet's animal and plant life, much of which we believe has not yet even been discovered. Sustainable use and development of the ocean, or the "blue economy", has tremendous potential to create jobs and economic value.

For decades, ocean observations have supported a scientific understanding of ocean processes, as well as forecast and warning products for those who live and work on or near the ocean and at the coasts. A very broad, but not well-coordinated collection of local, national, regional and international organizations has evolved to address these challenges.

Meanwhile, the ocean is changing. Shrinking ice caps, sea level rise, ocean acidification, degradation of coastal and open-ocean habitats, plastics and other pollutants, over-exploitation of fish populations, the death of coral reefs, other declines in biodiversity, extreme storms and coastal flooding -- these all pose increasing risks.

The challenge is great. The ocean is vast, variable, an expensive place to operate, and critically under-observed, especially in biological parameters. Satellite observations can provide a broad view of the surface, but only skin deep, making in situ observations a necessity.

Understanding, forecasting, and adapting to these growing risks urgently requires that more ocean information be collected, processed and made available in better ways to support multiple users -- governments for policy-making, businesses for safe and efficient operations on the seas and coastlines, scientists for greater understanding of ocean processes, and coastal citizens who are increasingly dependent on forecasts and warnings to protect them from local disasters.

## *THE OPPORTUNITY*

Public understanding of the importance of the ocean is growing, as is their awareness of threats such as plastic pollution and ocean acidification.

Governments and private industry have growing interest in promoting the ocean economy, and ensuring it develops sustainably. The UN's Agenda 2030 and its Sustainable Development Goals include an explicit ocean goal, in addition to the importance of ocean information in achieving many of the other 17 goals. The Decade of Ocean Science for Sustainable Development will run from 2021-2030 and bring innovative and transformative action, linking science including observations to action. This Strategy is aligned with their timetable.

The global need for collective action in responding to challenges on safety, climate and ocean health—and the need for sustained ocean observations—are enshrined in numerous international conventions. These include the UNFCCC's Paris Agreement and the Sendai Framework for Disaster Risk Reduction.

The capability of the ocean observing community is constantly evolving. The OceanObs'19 Conference (September 2019, Honolulu, USA, oceanobs19.net) will be an important touchstone event for improving user delivery of ocean observations, and its outcomes will help this strategy evolve.

## THE RESPONSE

The need for ocean observations is great and growing. No one nation or organization alone can meet this need.

A step-change is urgently required --

- in worldwide efforts to observe, analyze, understand and predict the ocean
- in interaction with a wide range of users to ensure ocean products are adequate to their needs
- in greatly improved international coordination, and
- in capacity building worldwide

The Global Ocean Observing System (GOOS) is the internationally recognized entity that can and should take on the challenge of coordinating this effort, with a broad range of partners and stakeholders.

This GOOS Strategy addresses these critical needs through 2030. An accompanying Implementation Plan is in development. It will provide details on specific, measurable goals for 1 year, 3 years, and 5 years.

## WHO WE ARE

The Global Ocean Observing System (GOOS) was established in 1991 by the Member States of the Intergovernmental Oceanographic Commission of UNESCO, with the World Meteorological Organization, UN Environment, and the International Council for Science joining as sponsors.

Over the past quarter-century, GOOS has worked successfully in coordinating global ocean climate observing and information products and promoting regional alliances. In 2012, GOOS adopted the community-designed and internationally-accepted Framework for Ocean Observing in order to serve a wider set of users—operational users for disaster risk reduction and economic benefit, and those monitoring human impacts on the ocean and its ecosystems.

Working in partnership with other international, regional, and national programmes, GOOS harnesses a strong ocean observing community, allowing them to see the value of individual sustained observations in regional and global contexts. Our common platforms for identifying requirements and coordinating different networks allow individual national observing programmes to leverage each other's investments.

Now we are looking forward to 2030, identifying our unique role, and how we will work with our partners to deliver our vision.

# OUR PRINCIPLES

## HOW WE DO IT

GOOS's core principles have been constant since 1998:

- User-driven design
- Sustained observations
- Regular evaluation
- Global standards and best practices
- Open data
- Capacity development

# STRATEGIC OBJECTIVES

GOOS has big ambitions for the observing system and what it can achieve by 2030.

Achieving our Vision will empower governments, communities and industry with the information to make the right decisions, generating profit and jobs in the marine economy, protecting ocean ecosystems, and managing risk from coastal hazards and climate change.

Over the next decade we will work towards a global system that is increasingly responsive to the needs of end users, and where service delivery around climate, operational and marine ecosystem health can be seamlessly delivered from a system of networks that spans physical to biologicalrealms, the coast to the open ocean, in situ and space based observing.

GOOS's role, its Mission, is to lead the ocean observing community in growing an integrated and sustained global observing system focused on enhancing scientific knowledge and delivering essential ocean information to end users.

GOOS acts as platform for coordination, which leverages all contributions to sustained ocean observing, and fully connects the value chain. This coordination scales up and adds value to everyone's piece.

GOOS brings focus, connection, efficiency or value for money for investors, can target and support capacity building, and bring visibility. The next decade will see the need for greater inclusion in a truly global governance system for ocean observing. The next decade will also see greater clarity of delivery and benefit for sustained investment.

GOOS has developed 8 Strategic Objectives which are the core aims of the program for the next decade. Combined they work towards our vision to deliver a fit-for-purpose Global Ocean Observing System that is founded on the voluntary collaboration of the ocean observing community, fully engages with partners in the delivery of ocean information for societal benefit, and leverages value for national and other funders.

The GOOS 2030 Strategy builds on the principles laid out in the Framework of Ocean Observing (the FOO), addressing the need for sustained ocean observations based on building value through identified user needs, data products and user engagement, developing the capabilities of GOOS to respond, and ensuring it has broad and lasting impact.

The 8 Strategic Objectives are organised into 3 action areas, Engagement & Impact, System Enhancement and Building for the Future. They are summarized below and available in greater detail over the following pages.

# GOOS STRATEGIC OBJECTIVES

*2018 - 2030*

## Engagement and impact:

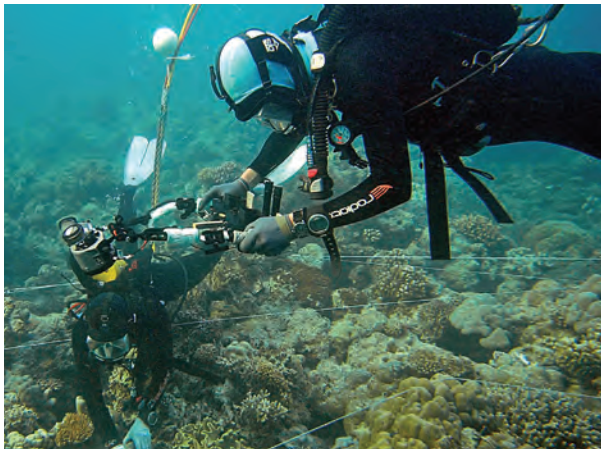
1. Strengthen partnerships, to improve delivery to end users from observations through forecasts, operational services, and scientific assessments
2. Building advocacy and visibility for the sustained observing system with stakeholders, including key users and national funders
3. Provide authoritative guidance to support implementation decisions on integrated observing at global, regional and national levels; synthesizing across a range of evolving requirements

## Enhancement:

4. Sustain, strengthen and expand observations coordination through GOOS and partner communities; supporting innovation in observing technologies and networks
5. Ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reusable - the FAIR principles; with appropriate quality and latency for multiple end users
6. Develop capacity to ensure broader participation in and benefit from GOOS

## Building for the future:

7. Develop metrics and regularly evaluate the ocean observing system to assess fitness-for-purpose as the system evolves to meet user requirements
8. Play a leading role in establishing effective governance for global in situ and satellite observing over the next decade, together with partners and stakeholders



# GOOS STRATEGIC OBJECTIVES 2030

*IN DETAIL*

## 1. Strengthen partnerships, to improve delivery to end users from observations through forecasts, operational services, and scientific assessments

Issue: GOOS coordinates for the core of the ocean observing system with a mandate to be responsive to end user needs. However, there is poor connectivity from observations through data systems to two major intermediate users: through models and forecast systems to operational services, and through to scientific users and into policy-relevant assessments. There is a lack of end-to-end design, implementation, and therefore delivery.

Action: GOOS needs to reach out to key end users (ultimately all end users) and work with stakeholders in the delivery or value chain from ocean observations to end users. GOOS understands that the value of a Global Ocean Observing System for society cannot be realized without partners in the value chain. Building on a strong base of partnership with the global climate research community, GOOS will work on building strengthened engagement with partners that improve the interface from ocean observing networks and data systems to key intermediate users involved in:

(1) forecast products and operational services, improving safety and reducing risk at the coast and on the oceans, as well as creating opportunities for the marine sector; and

(2) synthesizing scientific knowledge gained from sustained ocean observations, observations and model data into policy-relevant information and assessments to manage climate risk and sustain critical ocean ecosystem services,

GOOS will develop partnerships across climate, operational, and marine ecosystem health service areas to ensure the adequacy of the system to meet societal needs, to enhance delivery to end users and to provide evaluation mechanisms, leading to improved understanding of the requirements and the design of the system. In particular, GOOS will aim to make a major leap forward in establishing partnerships to link sustained observations and scientific assessment for sustaining threatened ocean ecosystem services.

Outcomes:

- An increase in fit-for-purpose ocean information products (forecasts, indicators) based on sustained observations
- A strengthened and responsive delivery focused observing system; key end users and value chain stakeholders become GOOS partners, to strengthen the end-to-end system and deliver flexible response through participation in feedback mechanisms

## 2. Building advocacy and visibility for the sustained observing system with stakeholders, including key users and national funders

Issue: Most funding of the current ocean observing system comes through individual nations investments, and within funding nation this is frequently fragmented across a variety of funding channels, and dependent on time-limited research projects. Although more than 70 countries participate in funding the observing system, only 6 nations fund 70% of the global ocean observing networks, which means that the system is vulnerable to shock. There is an urgent need for more nations to step up and support the system and for nations to recognise why and how they fund ocean observing, and the value that it generates.

Action: The role of GOOS is to give the vital work of the observing system community visibility with policy makers, funders and more broadly the general public, explaining why investment in OO is critical for assessments, projections and predictions of climate, ocean state and marine ecosystem health, and as a foundation for sustainable growth for all the aspirational "blue economies" of the world. This also includes explaining how GOOS coordinates and helps focus this work towards societal benefit areas and answering the many needs from an observing system.

Our role at a global level is to be an advocate into international processes (UN and other); at regional and national levels it is to arm the observing community with the communications material that helps them make the case at the appropriate funding levels, in a best practice broker role that find and spreads user stories that work, demonstrates value, and propagates across nations and regions, and into the global system.

Vocal advocates for the fundamental need for an ocean observing systems and for the work that GOOS community undertakes will be sought at all levels, but particularly within key requirement setters (e.g. UN SDG, IMO, … ) and national representatives and GOOS partnerships (see SO 1).

Outcomes:

- increased sustained funding for observations
- external recognition of global requirements for GOOS in climate, operational services, and marine ecosystem health
- a community external to ocean observing who are vocal advocates for the need for an evolving and sustained system

## 3. Provide authoritative guidance to support implementation decisions on integrated observing at global, regional and national levels; synthesizing across a range of evolving requirements

Issue: The requirements for the ocean observing system are expanding exponentially, with end users segmented in different economic sectors, looking for information on many time scales and for different purposes, extending GOOS from climate to operational services and marine ecosystem health. Creating a specific system focused on the needs of each is clearly not sensible nor economic. We therefore need to synthesise these requirements, through strong scientific and operational analysis, to offer guidance and focus towards achieving goals for society through a complex observing system space, that enables nations to understand where and why investment is needed, and maximises the utility of the observing system.

Action: GOOS will undertake multidisciplinary assessment and synthesis across a range of evolving requirements, to guide and support implementation decisions from global to regional, and across platforms, networks and technologies.

This starts with an understanding the needs for ocean information for public policy, individual and private sector decision-making, and the information products that serve those applications. Requirements need to be expressed against scientific or operational applications, the ocean phenomena that need to be sustainably observed to inform those applications, the Essential Ocean Variable specifications, the design of complementary satellite and in situ observing networks, and data system and flow requirements.

GOOS will test the utility of modular requirements responding to individual applications in developing coastal observing systems.

Through cycles of assessment, defining requirements, providing implementation planning/guidance, and tracking, the design of the system will evolve.

While maintaining a focus on in situ observations, GOOS will also refine the design together with the satellite observing community.

Ultimately GOOS will support understanding of trading space for investment, particularly to face global issues requiring global observing, enabling targeting of what is essential, combining high impact high technical and economic feasibility, identifying the highest value observations independent of platform or technology.

Outcomes:

- A refined design for essential global observations needed for global issues that maximises return on investment
- Testing of a modular design approach to guide and support implementation decisions at the national level

## 4. Sustain, strengthen and expand observations coordination through GOOS and partner communities; supporting innovation in observing technologies and networks

Issue: GOOS's core of 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 to deliver together to common data streams. Some applications require global observations with a global design, and the unique characteristics of each satellite or in situ platform to measure variables in space and time at different costs must be negotiated. All observing implementers can benefit from learning from best practices in global approaches, and many opportunities to serve more uses through integration exist. Observing technology evolves rapidly, while a sustained observing system has to balance continuity and responsiveness. Sound coordination delivers important returns on investment, this is about learn once use many times, observe once use many times, speeding technology development through market identification and aggregation, advancing rapidly in areas of most need.

Action: GOOS will build on coordination activity in the JCOMM Observations Programme Area, the GOOS Regional Alliances, GOOS regional projects, emerging biological and ecosystem observing networks, and national systems.

Creating stronger platforms for coordination leverages individual national and network contributions into a single collaborative system, and allows each network to deliver their niche of the observing system better. GOOS will increase focus on the development of multidisciplinary observing technology and systems

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 systems, and promotion of increasing readiness of new observing technologies and networks.

GOOS will encourage increased partnerships across the ocean research and operational communities to assess and improve the readiness levels of observation technology and platforms to measure each EOV by merging research and operational requirements into observing systems fit for both; and recognizing the availability of satellite observations when designing new in situ observing systems.

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.

Outcomes:

- Greater availability of ocean data through the adoption of common approaches
- Opportunities for observing network integration fully leveraged
- A system for identifying and sharing of ocean observing standards and best practices with widespread citation of documentation
- More observing networks, sensors and platforms with a Technology Readiness Level of 7 or higher: mature. Speeding of technological development for the observing system

## 5. Ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reusable - the FAIR principles; with appropriate quality and latency for multiple end users

Issue: The ocean sustained data system architecture, from acquisition to dissemination, is incomplete and 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 for 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 is not universal to biogeochemical and biological variables, and to certain areas under national jurisdiction. The data system needs to connect from observations to users, and be engaged in cycles of evaluation to ensure a fit for purpose and responsive system.

Action: Building on GOOS principles and IOC 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.

GOOS will track compliance of in situ observing networks to these principles, through specified Global Data Assembly Centres (often platform specific). We will engage with 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 availability for each EOV.

We will support the flow of data by promoting the use of modern information and communication technology, ensuring that data and associated metadata are discoverable. 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.

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.

Outcomes:

- An identified and tracked global observing system data architecture as part of broader oceanographic, atmospheric, and earth system data architectures
- Data products based on EOVs available in a timely manner, with appropriate quality

## 6. Develop capacity to ensure broader participation in and benefit from GOOS

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 techniques of observation, the design of responsive regional, multi-platform observing systems that also take advantage of global satellite and in situ observations, and the use of the data flowing from the system for science and specific applications, including meeting national reporting requirements under global agreements. Without this pull it is difficult to conceive of sustained new observing capacity.

Action: 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. This will require strong engagement with GOOS Regional Alliances and national ocean observing programmes.

Development will focus both on developing human capacities, as well as the transfer of marine technology including knowledge on observing techniques and best practices, based on GOOS EOVs and observing networks. Certain contexts may require the development of observing tools and best practice guides adapted to local conditions for deployment and maintenance of observing networks.

The engagement of countries that already have a strong marine science community can be done on modest 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.

GOOS will also seek to leverage bilateral programmes between nations and regions.

Outcomes:

- a greater number of countries actively funding, participating in GOOS, and benefiting from information products
- new best practices and data products addressing the needs of a larger and more diverse participating countries

## 7. Develop metrics and regularly evaluate the ocean observing system to assess fit for purpose as needs evolve

Issue: The *Framework for Ocean Observing* identifies the need for regular cycles of evaluation, 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 the observing system is designed for. At present, a framework for evaluation of global ocean observations for climate exists through the Global Climate Observing System, but we have little guidance to evaluate the observing system against other objectives, or on regional and local levels.

Action: Working through the Framework process and with the engagement and partnerships identified above, GOOS will support regular evaluations of how the observing system is delivering fit-for-purpose information for societal benefit areas and applications.

The requirements expressed against applications and knowledge challenges, agreed-on Essential Ocean Variables, satellite and in situ observing networks, and the data system will guide this process.

We aim to have measurable metrics to evaluate the performance towards delivering on high level global mandates, and provide best practice guides on evaluations that are performed for regional, national, or local objectives.

These metrics should capture the status of the observing networks, data flow to science users and models, the impact of the data, and governance.

As GOOS projects and other innovation activities improve the capabilities of the system, these evaluations and metrics will have to evolve.

Outcomes:

- Identification of global observing system status and gaps in a compatible way across the earth system (disciplines and domains), and intersecting global, regional, and local scales. More efficient use of observing resources to meet an integrated set of requirements
- operational tracking of the adequacy of the observing system against targets for climate, operational services, and marine ecosystem health; widespread citation of GOOS standards and best practice documentation; opportunities for observing network integration fully leveraged

## 8. Play a leading role in establishing effective governance for global observing over the next decade, together with partners and stakeholders

Issue: As we grow from a focus on serving climate science and policy, to serve a broader suite of users across operational services and marine ecosystem 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 and acronym soup of organizations and networks, working on different links in the value chain from observations to end users; at the global, regional, and national levels; often with aims for delivery to different segments of users. An inclusive and global governance architecture with effective processes is needed for ocean observing, to enable direction-setting and coordination of this increasingly complex system, and supporting local implementation.

Action: Building on engagement with stakeholders, key users, and funders, we will foster a discussion with the ocean observing community on the characteristics of good governance, which can set global directions and design for observations that respond to global issues, and foster global approaches that ease local implementation of ocean observations.

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, or local), and identifies principles, institutions and processes of this governance through a best practices and consensus-building approach, building on existing structures wherever possible.

Ultimately, this aspect of the observing system should also undergo regular cycles of evaluation: of the outputs (the arrangements in place), the outcomes (the changes in behavior of the parts of observing community party to these arrangements), and the impact (better ocean observations serving end users).

A good governance architecture will allow the ocean observing community to speak with one voice, ultimately strengthening the observing system and its delivery to end users.

Outcomes: Nested global, regional, and national governance architecture for GOOS and related regional and national programmes, with clarity in roles and processes; a cycle of evaluation of governance; and a clearer single voice for ocean observations.

# ELEMENTS OF IMPLEMENTATION

## *A BROAD OCEAN OBSERVING PARTNERSHIP*

Through its common sponsors, GOOS maintains close ties to the *Global Climate Observing System* (GCOS) for identification and delivery of systematic observations and products relevant for climate, and with the *Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology* (JCOMM) for coordination of global observing networks and links into weather-related operational services and systems.

In addition to GOOS sponsors and partners mentioned above, there are numerous other important ocean observing system efforts: Observations of the ocean surface from space have long been led by the *Committee on Earth Observation Satellites* (CEOS) founded in 1984. Many data management systems are coordinated under the IOC's *Oceanographic Data and Information Exchange* (IODE) established in 1961. Operational ocean forecast systems were developed under the *Global Ocean Data Assimilation Experiment* (GODAE) founded in 1997. The *Group on Earth Observations* (GEO), founded in 2005 after the World Summit on Sustainable Development, highlights the need for coordinated observations to deliver societal benefit. And the *Partnership for Observation of the Global Ocean* (POGO) was founded in 2009, with leaders of major oceanographic institutions around the world focused on the implementation and integration of international global ocean observing systems.

Based on general consensus at the OceanObs'09 Conference in Venice, Italy in 2009, a working group of international programme representatives proposed a systematic approach for the global community to define requirements for ocean observations, decide appropriate technology for measurements, and assess data standards and dissemination. The resulting **Framework for Ocean Observing (the Framework)**, published in 2012, has been widely endorsed by the expanding ocean observing community, and adopted formally by GOOS as a guiding document.

## GOOS STRUCTURES NOW

GOOS is guided by a Steering Committee, with ten expert members appointed by the IOC Executive Secretary in consultation with sponsors, and five members selected by IOC regional electoral groups. The Steering Committee reports to the IOC Assembly and other sponsors, defines the GOOS work plan, and manages the structures that report to it.

The GOOS Programme Office, headquartered at the IOC, is now a distributed office with in-kind contributions from a number of supporting agencies.

The major focus of GOOS in recent years has been on establishing three Expert Panels -- for Physics and Climate, Biogeochemistry, and Biology/Ecosystems -- and guiding their efforts in using the Framework to identify Essential Ocean Variables (EOVs). New ocean biology and ecology observing groups have particularly embraced the Framework because the existence of a common language and set of processes is helping them to organize, and will enhance their collaboration and data-sharing with other ocean monitoring groups. All three of these Panels have identified and agreed upon Essential Ocean Variables (EOVs) for their fields, and the recommendations are now being vetted by their scientific and operational user communities.

Two GOOS Projects are exercising the Framework processes. The Tropical Pacific Observing System (TPOS) is focused on an ocean region of high importance to global seasonal climate, and the Deep Ocean Observing Strategy (DOOS) is designing and implementing an observing approach for the very under-sampled areas of the deep sea. These projects cut across GOOS requirements, expert panels and observing systems, and can provide lessons learned and best practices for future efforts. The GOOS Regional Alliances have approved and are seeking funding for regional projects, the first of which (MESCAT) is focused on sea level measurements in the Mediterranean. These projects are supported only for limited times, though, and follow-up funding is needed for implementation and development of lessons learned.

Participation in GOOS also implies a commitment to help less-developed countries to participate and benefit. Beyond this moral responsibility, trans-boundary issues in the ocean continue to grow, and a global and sustainable GOOS requires a determined level of capacity development. Much of this work is being done through the GOOS Regional Alliances (GRAs).

## IMPLEMENTING THE STRATEGY

To realize the GOOS vision, mission, and strategy, the structures of GOOS will be oriented and aligned, and new task teams created where necessary. improved collaboration, common design and advocacy, and engagement are critically needed. GOOS will engage broadly with partners to deliver in areas where present structures cannot do the job alone. We will communicate to our partners how we plan to work more closely with them: where we will partner, where we will interface, and where we will provide enhanced global leadership.

Engagement with stakeholders, funders, and users of GOOS will be ramped up, so that GOOS can be:

- an advocate of the value of sustained ocean observations, directly with relevant global conventions, and through example and resources for application at the national level,
  a hub of cooperation for observing networks, regional and national GOOS programmes, and
- a global platform for agreement on how to implement GOOS, and how to build its capacity to respond to a greater set of societal drivers globally, and for an increasing number of individual countries.


United Nations
Educational, Scientific and
Cultural Organization

Intergovernmental
Oceanographic
Commission