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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

**Fourth Meeting of the Global Ocean Observing System
Steering Committee (GOOS SC-4)**

Australian Institute of Marine Science, Townsville, Australia
24–26 May 2015

EXECUTIVE SUMMARY

In accordance with Rule of Procedure 48.3 and Resolution XXVI-8, GOOS SC, as a Primary Subsidiary Body of IOC, is required to report to a Governing Body on its meetings.

The IOC Assembly at its 28th Session will be invited to consider this Executive Summary, with particular attention to the recommendations made to it by its scientific and technical intergovernmental subsidiary body.

Background

1. The IOC Assembly in 2011 reformed the governing structures of the Global Ocean Observing System (GOOS) through Resolution XXVI-8, and aligned it with a Framework for Ocean Observing (IOC/INF-1284) and an Essential Ocean Variable (EOV) approach, as developed after the OceanObs'09 conference (21-25 September 2009, www.oceanobs09.net). The GOOS Steering Committee (SC) is responsible for developing a work plan for approval by the IOC Assembly to update GOOS requirements, monitor and promote its development, assess the performance of the observing system, and advise on developing capacity of Member States. GOOS as a programme delivers strategic oversight, coordination, evaluation of sustained ocean observations for climate, services, ocean health; and entrains a wide voluntary effort from research and operational ocean observing community
2. The First Meeting of the GOOS Steering Committee (GOOS SC-1, 20–22 June 2012, Paris, France) established a work programme around three themes: 1. sustaining present observations; 2. expanding to new variables and serving new requirements; and 3. identifying regional priorities, capacity, and addressing gaps. The Committee highlighted the strength of treating sustained research and operational observations together, and agreed on the utility of the Framework for Ocean Observing and its focus on EOVs in articulating the multiple 'missions' addressed by a single observing system. It emphasized the importance of reaching out to users in helping to evaluate observing system performance and identify requirements. It decided to base its work on physical EOVs, including GOOS requirements

for real-time services and in the coastal ocean, around the Ocean Observations Panel for Climate (OOPC) shared with the Global Climate Observing System (GCOS) and the World Climate Research Programme (WCRP). It decided to work with the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) as the nucleus of a panel for carbon and biogeochemical variables, recognizing that any expansion in mandate would require additional funding and personnel support. It also decided that it would seek to develop a biology/ecosystems panel in cooperation with partners. The Committee further recognized the importance of the GOOS Regional Alliance (GRA) concept, as a way of engaging national action at a regional level that was often seen as most appropriate to the issues faced by Member States. The Committee recognized the need to develop capacity as a key element for global participation in GOOS, and in particular the need to identify and develop approaches to potential funders.

3. The Second Meeting of the GOOS Steering Committee (GOOS SC-2, 25-27 March 2013, Qingdao, China) was hosted by the Institute of Oceanology of the Chinese Academy of Sciences, with participation of scientists from the First Institute of Oceanography, State Oceanic Administration. The Committee adopted terms of references for the three GOOS panels reporting to the SC and sponsors, focused on: reviewing and prioritizing observing requirements, assessing technology readiness and system adequacy; coordinating observing networks (together with the JCOMM Observations Programme Area Coordination Group), promoting best practices and standards, and developing metrics of implementation; working with relevant groups to improve data management arrangements; and developing processes for ongoing evaluation of the observing system. The SC agreed that there were inadequate funds to support the critical operations of three panels, and it thus resolved that the available funds should be directed towards the viable operation of only one panel—the OOPC—and that plans for the GOOS Biogeochemistry and GOOS Biology and Ecosystems panels and observing system components should be shelved until such time as adequate resources are identified. It identified fundraising as a key priority. The Steering Committee reaffirmed GOOS Regional Alliances as a structural element of GOOS, and developed a revised GOOS Regional Policy which was adopted by the 27th Session of the IOC Assembly, along with approval of the Mediterranean Oceanography Network for the Global Ocean Observing System (MONGOOS) as an additional GOOS Regional Alliance, merging the former MedGOOS GRA with the EuroGOOS Mediterranean Operational Oceanography Network (MOON).
4. The Third Meeting of the GOOS Steering Committee (GOOS SC-3) took place 24-26 July 2014 in Barcelona, Spain. The Steering Committee adopted the GOOS Strategic Mapping concept as a way to identify the link between three major themes - observations responding to requirements for climate, real-time services, and ocean health - to EOVs and observing networks. The physics and biogeochemistry panels agreed to work on Essential Ocean Variable specification sheets, and metrics and risk information for the observing networks underneath. The Steering Committee reaffirmed the importance of standards, reference material, and information and training on sensors as a resource for the ocean observing community. Two new co-chairs for the Biology and Ecosystems panel were appointed. The Steering Committee approved two GOOS development projects, one focused on the Tropical Pacific Observing System in 2020, and the other on a Deep Ocean Observing Strategy. The GOOS Regional Alliances (GRAs) launched a modeling capacity survey to underpin future capacity development activities, noting however the lack of central resources to support GRA activities. The Steering Committee adopted a GOOS Communications Strategy for internal and external communications. The 47th Session of the IOC Executive Council (2014) recognized the Australian Integrated Marine Observing System (IMOS) as a GOOS Regional Alliance based on the criteria in the GOOS Regional Policy 2013 (IOC/INF-1308).

5. The GOOS Steering Committee is co-chaired by John Gunn (AIMS, Australia) and Eric Lindstrom (NASA, USA), and includes five regionally-appointed expert members, ten expert members representing a broad range of observing efforts and disciplines, and ex officio members from the GOOS Regional Forum (of GRAs), JCOMM, IODE, and partner organizations.

Outcomes of GOOS SC-4

6. The Fourth Meeting of the GOOS Steering Committee (SC-4) took place 24-26 May 2015 in Townsville, Australia, hosted by the Australian Institute of Marine Science, who provided all local costs. The Committee welcomed project based and in kind support that had allowed development of activities under the Physics Panel (OOPC, technical secretariat: Katy Hill, GCOS, Geneva, Switzerland), the Biogeochemistry Panel (led by IOCCP, project director: Maciej Telszewski, Sopot, Poland), a new Biology and Ecosystems Panel (international project officer: Patricia Miloslavich, AIMS, Townsville, Australia; and Ward Appeltans (50%), IOC Project Office for IODE, Oostende, Belgium), and additional in kind support through the US Consortium for Ocean Leadership and NOAA. This has created a distributed GOOS Office coordinated through the IOC Secretariat in Paris, building as well on the secretariats of the GOOS Regional Alliances. These project based and in kind contributions have allowed a fuller set of GOOS activities, notably in biogeochemical and biological observations, to advance, despite IOC regular programme resources being concentrated on sustaining the present system and activities.
7. The Committee reviewed information from the Joint IOC-WMO Technical Commission for Oceanography and Marine Meteorology (JCOMM) on the status and risks of the in situ global ocean observing networks. For the in situ sustained ocean observing networks with global targets defined for climate, the observing system in late 2014 recovered its previous status, particularly for the tropical Pacific TAO mooring array and drifting buoys. While the number count for many platforms is good, the spatial coverage of distribution of observations could be improved. The monitoring metrics of the status of observations are an area of identified work for JCOMM together with GOOS.
8. The Committee identified the need to build on the core work of the JCOMM Observations Coordination Group (OCG) to build effective and efficient additional coordination activity with existing biogeochemical and biological observing networks that have common issues in observing platforms, standards and best practices, and data and metadata issues. This could take the form of a 'super-OCG' that builds on the core JCOMM OCG with additional GOOS and GRA networks.
9. The Physics panel (the Ocean Observations panel for Physics and Climate OOPC, shared with the Global Climate Observing System GCOS and the World Climate Research Programme) serves as the link between GOOS and GCOS reporting to the UN Framework Convention on Climate Change (UNFCCC). It is deeply involved in the present cycle of reporting on the status of the global observing system for climate, as well as the development of a revised Implementation Plan in 2016 that will address global climate cycles and the increasing need for information for adaptation to climate change. GOOS will advocate that emerging Essential Climate Variables are included in GCOS reporting, to better capture the work of all three GOOS panels. The OOPC work plan¹ builds on a mature system for climate observations, and its next near-term priority for systems-based evaluation will focus on boundary currents and inter-basin flows, in doing so integrating requirements for coastal users at the level of global phenomena.

¹ [available on the GOOS website](#) (click link)

10. Biogeochemistry Panel activities (led by the SCOR-IOC International Ocean Carbon Coordination Project, IOCCP) have been able to move forward primarily through funding from two European Commission research projects: GEOWOW (2011-2014) which focused on supporting assessments of ocean state with interoperable access to Essential Ocean Variables, and the new AtlantOS project (2015-2019), as well as other funding sources for specific complementary activities. The Panel defined nine biogeochemical Essential Ocean Variables key to support universal climate and ocean health objectives through global sustained ocean observations, balancing feasibility and impact based on Framework for Ocean Observing principles. These are detailed in EOVS specification sheets².
11. A draft GOOS Strategic Mapping³ links the societal benefits in the three themes of climate, real-time services, and ocean health to scientific issues, applications and products; and onwards to the Essential Ocean Variables and types of observing networks that take these essential observations. The Committee reviewed the Strategic Mapping, and highlighted the need to reflect in different versions the regional and even national priorities and capacities brought as contributions to GOOS. The GOOS Regional Alliances had already collected a large amount of this information. The Strategic Mapping is a place for the work of evaluation of the system to be captured through the work of the panels and the GRAs. Once a first release is complete from GOOS, the tool will be released for wider use in communicating about the interdependence and integration of the observing system, as well as the key place the individual observing networks hold.
12. The co-chairs of the new GOOS Biology and Ecosystems Panel, Nic Bax (CSIRO, Australia) and Samantha Simmons (MMC, USA), reported on an approach to biological and ecosystems observations that would build an understanding of the already-existing essential observations, identifying gaps; and an analysis of the common sustained observing needs of global assessment and governance efforts—such as the World Ocean Assessment, indicators for Sustainable Development Goals, the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES), the Convention on Biological Diversity (CBD), agreements under the Fisheries and Agriculture Organization (FAO), etc. These activities were strongly supported by the contribution of salary support from the Australian Institute of Marine Science (AIMS) and University of Western Australia (UWA) for an international project officer as well as the involvement of the OBIS project director, Ward Appeltans (IOC).
13. A central preoccupation of the Committee was on improving communications about the activities of the GOOS programme with three major audiences: (a) to the broad sustained ocean observing community participating in regional and global observing networks (for multiple purposes: monitoring, setting goals, understanding risks, promoting standards, best practices, coordinating activities, and capacity development); (b) to parallel efforts coordinating and advocating for sustained observations (including with the Partnership for Observation of the Global Ocean POGO, the Committee on Earth Observing Satellites CEOS, and the GEO Group on Earth Observations Blue Planet task); and (c) to funders and potential funders of ocean observing efforts. GOOS Updates (newsletter), monthly Webinars⁴, and a Twitter account⁵ will be joined by a new website and printed material focused on the work of the programme (funded by NASA). The Committee identified the importance of working with partners to identify and promote the fundamental role and impact of observations in developing a wide range of information products and services for different user communities, and the need to treat these one by one.
14. The Committee reaffirmed the development of a project-based approach to building readiness for sustained ocean observations. It reviewed the progress of the Tropical Pacific

² [available on the IOCCP website](#) (click link)

³ [draft available online](#) (click link)

⁴ Receive updates by joining the GOOS mailing list at ioc-goos.org/join

⁵ Follow @GOOSocean on Twitter

Observing System in 2020 project (TPOS 2020), and its plans to draft recommendations for a step change in tropical Pacific observations. The Committee emphasized the importance of building a business case linked to the deliverables, notably in seasonal forecasting and the provision of climate services. The Committee also reviewed progress in setting up a Deep Ocean Observing Strategy project, and emphasized the importance of maintaining strong links with the AtlantOS project (aiming to leave a legacy for GOOS of better integrated and sustained observations for all countries around the Atlantic) and the Global Ocean Acidification Observing Network (GOA-ON).

15. The need to improve the two way communication and common work and projects with the GOOS Regional Alliances was another major point of discussion. The GRAs have worked collectively over the last few years in a number of surveys of regional priorities and capacity, and model use and capacity. The GOOS Regional Fora was maintained in 2013 due to Emergency Funds, and will be held in 2015 due to funding from NOAA (IOOS) and the reinforcement of UNESCO funding for IOC. These Fora have been important for exchange of best practices between the GOOS Regional Alliances, for observing networks and for the organizational practices that have led to sustained ocean observing systems.
16. One priority of the upcoming GOOS Regional Forum (22-24 September 2015, Heraklion, Crete, Greece) will be to build on the work of the past few years in building on the survey-based understanding of GOOS Regional Alliance priorities and capacities, to develop bilateral and multilateral projects that help the GRAs better deliver to regional and national users.
17. The Committee began to develop plans for the OceanObs'19 conference (2019) which will build on the decadal OceanObs series.
18. GOOS Steering Committee members provided individual action plans that they committed to for the development of GOOS.
19. The GOOS Steering Committee suggests the Work Plan found in Annex 1 and the budget implications found in Annex 2 (subject to the IOC Programme and Budget Resolution) for approval by the 28th Session of the IOC Assembly.

Annex 1. GOOS Work Plan 2016-2017

The Steering Committee proposes the following Work Plan outline for approval by the IOC Assembly. This will respond to all of the objectives set out in the draft IOC Medium Term Strategy for 2014–2021 (IOC-XXVII/2 Annex 3), while concentrating on function B (*Maintain, strengthen and integrate global ocean observing, data and information systems*) and the cross-cutting Capacity Development function F, and builds upon the previous GOOS Work Plan.

WORK PLAN TASKS AND OBJECTIVES

1. Develop a living GOOS Strategic Mapping with global and regional goals and milestones, drawing where possible on existing implementation plans and processes.
2. Through the SC, its panels, and partner programmes JCOMM and IODE, exercise the Framework for Ocean Observing for global observing networks; with the objectives of (i) sustaining present observations and (ii) expanding to new variables and serving new requirements; and more specifically to:
 - a. engage with key global conventions, assessments, and Member States on their needs for ocean information to address societal challenges, and to define or refine observing requirements for Essential Ocean Variables in collaboration with the scientific and ocean observing communities; assess the readiness of observing system elements, based on their feasibility and impact in addressing requirements; and contribute to a GOOS Implementation Plan,
 - b. coordinate platform-based observing networks and elements, promoting the use of standards and best practices, engaging the GOOS Regional Alliances and national programmes, developing opportunities for collaboration and common technical support, encouraging data sharing, and developing metrics for information,
 - c. review the status and requirements for data management arrangements together with partner organizations, with emphasis on improving data interoperability, and
 - d. develop processes of ongoing evaluation of the observing system in liaison with ocean analysis and forecast activities and users.
3. Improve GOOS Regional Alliance implementation with a particular focus on capacity development,
 - a. identifying regional priorities, capacities, and addressing gaps through the development of GOOS Projects of mutual benefit at the global and regional levels, and
 - b. maintaining ongoing communication and reporting in both directions between the GOOS Project Office and GRAs.
4. Set a framework for promotion and review of GOOS Projects, and develop fundraising and outreach efforts for all elements of GOOS:
 - a. engaging IOC Member States (including through regional Sub-Commissions), GOOS Regional Alliances, and the scientific community, and
 - b. identifying and developing engagement with potential donors to the GOOS Programme.
5. Promote the GOOS as a system and a programme through communications activities targeting: (i) internal ocean observing community audiences at the global and regional levels, (ii) partner organizations with strategic contributions to the goals of GOOS, and (iii) to funders and potential funders of GOOS and its projects.

Annex 2. Operations: financial and human resources required for the work plan

A table below details the operations in support of the work plan activities, an estimate of the activity funds required for full work plan execution, the human resources required, and the expected regular programme and extrabudgetary support (financial and human) for 2016-2017, with explanatory notes.

Overall full implementation of the work plan above for 2016-17 is estimated to require US\$1.15M in financial resources, and about 6 full-time equivalent (FTE) professional staff in the GOOS Office and in dedicated in kind support in other locations (presently at the Australian Institute of Marine Science for GOOS biology, the Institute of Oceanology of the Polish Academy of Sciences for IOCCP, the WMO-based GCOS Secretariat for OOPC, and the Consortium for Ocean Leadership USA). The staffing needs and additional specific regional budget needs for the GOOS Regional Alliances, through IOC Sub-Commissions and other dedicated support offices, are substantial and in addition to those identified here.

In the draft IOC Programme and Budget for 2016-2017 (IOC-XXVIII/2 Annex 3), the \$518M ZNG+ scenario covers less than half of this activity financing requirement. Significant resources have been identified through in kind contributions and project contributions, allowing a good part of the GOOS work programme to move forward. One large area of additional fundraising effort required is to support GOOS-related projects at the regional level.

The GOOS SC will work with its panels and the GRAs to develop GOOS Projects that may bring additional funds. It will also seek cash contributions, secondments, and other in kind support from IOC Member States.

Budget area	Activity (USD)			Staffing (FTE) requirement for GOOS			Notes
	Need	IOC RP (\$518M scenario)	identified EXB contribution	Need	IOC	project, in kind, other identified	
GOOS general: outreach, web, office functioning	\$250,000	\$54,000	\$50,000	1.5	0.5	1	EXB: NASA in kind; Staffing: via NASA/NOAA in kind contribution, EC H2020 AtlantOS project
Steering Committee	\$100,000	\$70,000	\$20,000	0.5	0.5	0	EXB: expected WMO contribution
Physics panel (OOPC)	\$100,000	\$60,000	\$30,000	1	0	1	EXB: GCOS/WCRP contributions to OOPC; Staffing: via NOAA contribution to GCOS/WMO
Biogeochemistry panel (led by IOCCP)	\$100,000	\$35,000	\$20,000	1	0	1	EXB and Staffing: via EC H2020 AtlantOS project
Biology and ecosystems panel	\$150,000	\$35,000	\$50,000	1.5	0.5	1	EXB: Australia (AIMS, UWA, CSIRO); Staffing: 0.5 IOC (W. Appeltans), 1 Australia (P. Miloslavich)
GOOS Regional Alliances: GRF, project activities	\$450,000	\$174,000	-	0.5	0.25		RP: \$40k for GOOS Regional Forum, \$44k through IOCAFRICA, \$90k via Perth for IIOE-2 activity; Staffing: only for HQ coordination, does not include staffing requirement in GRA support offices
Total	\$1,150,000	\$428,000	\$170,000				
Does not include GOOS projects which are managed independently							