INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)

Thirtieth Session of the Assembly
UNESCO, Paris, 26 June–4 July 2019

Item 3.2 of the Provisional Agenda

REPORT OF THE EXECUTIVE SECRETARY ON THE WORK ACCOMPLISHED SINCE THE TWENTY-NINTH SESSION OF THE ASSEMBLY
(July 2017–May 2019)

Summary

This report presents a summary of the activities carried out by the Member States and Secretariat since the 29th session of the IOC Assembly (June 2017) up to May 2019. This document and the “Report on Budget Execution 2018 Outline of 2019 Budget” (IOC-XXX/2 Annex 2) are the two working documents that support the oral presentation of the Executive Secretary to the plenary session of the Executive Council.

Decision proposed: The Assembly is invited to take note of this report as in the decision referenced as IOC-XXX/Dec.3.2 in the Provisional Action Paper (document IOC-XXX/2 Prov.)
INTRODUCTION BY THE IOC EXECUTIVE SECRETARY

Since the 29th session of the IOC Assembly, the concerns about the situation with climate and ocean health have only increased. In its *Special Report on Global Warming 1.5°C*, the IPCC warned about significant consequences of even such model warning for the planet and its ocean. Yet, the year 2018 was characterized by the largest anthropogenic emissions of carbon in history. Such emissions will take us to a considerably warmer and much less hospitable world. Multiple evidence points at increasing impacts of multiple stressors on the ocean health.

Four objectives of the Ocean Sustainable Development Goal 14 are maturing in 2020. They will not be achieved in their totality, but some positive changes have started to occur. Following the UN Ocean Conference in New York in June 2017, there is a surge of voluntary activities to protect the ocean. They include the nine “Communities of Ocean Action”, the “Sustainable Ocean Action Platform” of UN Global Compact, and the “Friends of Ocean Action”, associated with the World Economic Forum. IOC is active in all of them. The IOC Chairperson Prof. Peter Haugan provides scientific guidance to the high-level group of Heads of States and governments focussing on sustainable blue economy, established by the Norwegian Prime Minister.

The need for science-based ocean management is starting to manifest itself in decisions of United Nations and governments. In December 2017, the UN General Assembly at its 72nd session proclaimed the UN Decade of Ocean Science for Sustainable Development (the “Decade”) for years 2021–2030, as proposed by IOC. The need to capitalize on science transcends the discussions of the Intergovernmental Conference on Conservation and Sustainable Use of Biodiversity Beyond Areas of National Jurisdiction (BBNJ). In June 2019, the UN Open-ended Informal Consultative Process on the Ocean and Law of the Sea will focus on ocean science and the Decade. The second UN Ocean Conference, to be hosted by Kenya and Portugal in Lisbon in June 2020, is focussed on moving “from Science to Action”. Ocean science indeed starts to support existential issues and inform increasingly binding ocean-related decisions in the domain of sustainable development. However, ocean observations, science, and even many life-supporting services are still largely funded by research agencies, remaining insufficiently sustainable.

In the two-year period since the last IOC Assembly in July 2017, the intensity and the scope of work of the IOC Secretariat have increased significantly. The Secretariat supports six IOC’s regular functions, leads the preparations of the Decade, maintains IOC activities and responsibilities in the UN system, and is a part of the UNESCO extensive planning, budgeting and reporting scheme at the same level of managerial responsibilities as other UNESCO sectors. Despite successful delivery on an increasing range of important tasks, the Secretariat’s size and resources are becoming more and more incompatible with the scope of work. Perspectives for the regular programme budget increase are not considered under the budget scenarios foreseen for the next biennium 2020–2021 (Draft 40 C/5). The Executive Secretary will analyse this situation in his presentation on the relevant agenda item and will invite Member States to discuss all opportunities to address it, building on the provisions of the IOC Statutes.

With the terms of service of all but one IOC Officers expiring at this coming Assembly, I would like to thank Professor Haugan and the team of Vice-Chairpersons for their strategic guidance of the Organization and its Secretariat and for their personal commitment to, and investment in, the goals and activities of IOC. I am most grateful to the IOC Secretariat - professionals, general staff, consultants and interns - for their truly excellent work in the intersessional period.
PART I

OVERALL STRATEGIC ASSESSMENT

(abstract from 206 EX/4.1)

Key Achievements

1. The end of the year 2017 was very special for the Intergovernmental Oceanographic Commission (IOC) with the endorsement by the 72nd Session of United Nations General Assembly of the IOC’s proposal to proclaim the years 2021 - 2030 the United Nations Decade of Ocean Science for Sustainable Development (the Decade). In July 2018, the IOC Executive Council at its 51st session approved the Decade “Roadmap” document intended to guide the preparation process in terms of preliminary objectives, societal outcomes, governance and engagement processes. The Council decided to establish an Executive Planning Group (EPG) consisting of high-level experts and a Stakeholder Forum, open to a broad range of communities. IOC convened the first meeting of the EPG from 17 to 19 December 2018 to brainstorm on scientific, governance, communications, and engagement elements of the Decade ahead of a first Global Planning Meeting and a series of regional consultations foreseen in 2019. Experts also sought to lay out the basis for an effective strategy to communicate the objectives of the Decade, engage stakeholders, and ultimately influence behaviours and perceptions of scientists, decision-makers and the public.

2. The 17th UN Oceans meeting hosted by the IOC at the UNESCO Headquarters in March 2018 reinforced the collaborative approach to ensure a meaningful division of labour among the IOC partners in the United Nations system.

3. UNGA A/RES/71/313 requested the Statistical Commission, through the Inter-Agency and Expert Group on Sustainable Development Goal Indicators, to further refine and improve the global indicator framework in order to address coverage, alignment with targets, definition of terms and development of metadata and to facilitate implementation. As a custodian agency for the SDG indicator 14.3.1, in the course of 2018, IOC and its networks, including the Global Ocean Acidification Observing Network (GOA-ON), developed the methodology to support its Member States’ reporting on progress. This resulted in the decision to upgrade the indicator from Tier 3 to Tier 2. With the internationally established methodology and available standards, the IOC will now work with countries to ensure regular production of data, which is required to move the indicator to Tier 1 status.

4. The IOC’s Global Ocean Science Report represents the core methodology to measure progress in the achievement of the SDG Target 14.a, of which the IOC has the custodianship. The first edition resulted in the indicator upgrade to Tier 2, and it is expected that the second edition, started with the support of the Republic of Korea, Belgium (Flanders) and the Western Indian Ocean Marine Science Association, will allow the methodology to achieve Tier 1 status.

5. IOC’s leadership took an active part in the first session of the Intergovernmental Conference for the future International Legally Binding Instrument (ILBI) on the conservation and sustainable use of the biodiversity in areas beyond national jurisdiction (BBNJ), United Nations Headquarters, from 4 to 17 September 2018. This conference kicks off a three-year negotiation process whereby United Nations Member States will, within the framework of UNCLOS, need to agree a new global regime that regulates access to and shares the benefits derived from marine genetic resources, as well as protect marine biodiversity. Many countries highlighted the potential role of IOC in supporting the future agreement, particularly with regards to capacity development and transfer of marine technology (including data services through the IOC Ocean Biogeographic Information System), to make this instrument universal, serving all its future Parties and developing countries in particular.

6. IOC actively participated in the Sustainable Blue Economy conference organized by Kenya and Canada, from 26 to 28 November 2018 in Nairobi, with a clear message: knowledge must be at the forefront, not the sidelines, of the blue economy debate. Through three flagship events, IOC
highlighted the role of science and ocean observation in supporting economic development of maritime nations. As a key framework for organizing marine activities in a sustainable way, IOC also put forward its experience in supporting nations in the implementation of maritime spatial planning.

7. The two millionth profile taken by an Argo float in November 2018 was emblematic of the sustained operation by Member States of the Global Ocean Observing System (GOOS), and the continuous challenge of coordination and advocacy for the system, led by the IOC. Twenty-six Member States deploy Argo floats, and more than seventy are active contributors to GOOS through one of its observing networks or GOOS Regional Alliances. The observations are a foundation of ocean science, as well as delivery information used in operational services improving safety and the ocean economy, climate mitigation and adaptation, and sustaining ocean ecosystem services and ocean health.

8. After more than four years of international collaboration, coordinated by IOC, the South China Sea region has now its own dedicated Tsunami Advisory Centre. Inaugurated on 8 May 2018 it serves as a warning system for nine countries in the region. IOC convened a high-level panel event on Reducing Human and Economic Impacts from Tsunamis at UNESCO as a contribution to the third edition of World Tsunami Awareness Day. The meeting exemplified real impacts of tsunamis for SIDS and their coastal tourism sector, and underscored the need for continued community preparedness to avoid complacency. IOC led Tsunami Exercises to raise awareness and exercise the systems. The Indian Ocean IOWave 18 exercise (4–5 September 2018) involved 24 countries and 119,000 people were evacuated.

9. The Palu tsunami on 28 September 2018 caused significant loss of lives and property damage. Initial findings about the nature of that dramatic event are emerging from the post-tsunami field investigations by the International Tsunami Survey Team, coordinated by IOC at the request of Indonesia.

10. In collaboration with the International Blue Carbon Initiative, IOC developed a methodology to measure blue carbon storage to assist national reporting to the UNFCCC. At the side events during the UNFCCC COP-24, the Commission highlighted the potential of blue carbon ecosystems as a Nature-Based Solution for the Nationally Determined Contributions to mitigate climate change under the Paris Agreement.

11. The implementation of the voluntary commitment “Ocean Literacy for All” announced at the first UN Ocean Conference continued thanks to the support of the Swedish Government. The IOC has launched the Ocean Literacy Platform and produced a toolkit, which is currently being tested in schools of 36 countries through ASPNet.

Global Priority Africa

12. In the framework of the Second International Indian Ocean Expedition (10 June–13 July 2018), IOC Africa and the South African Department of Environmental Affairs (DEA) organized the second regional cruise on board of the South Africa oceanographic research vessel. The vessel undertook surveys in the waters off Comoros, Madagascar, Mozambique, South Africa and United Republic of Tanzania. More than 50 marine scientists and students from Comoros, Kenya, Madagascar, Mozambique, Nigeria, and United Republic of Tanzania joined the cruises.


14. Several activities were organized under the framework of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS) for African Member States bordering the Indian Ocean. Capacity development continues to be a key area of focus, with the Ocean Teacher Global Academy (OTGA) regional training centres in Africa having trained 52 trainees from 18 Member States. IOCAFRICA organized four workshops on Marine Spatial Planning, attended by 75 trainees from 20 Member
States. A workshop on Strengthening Global Governance of Large Marine Ecosystems and their coasts, funded by the Global Environment Facility (GEF), gathered 30 participants from 14 countries in Dakar, Senegal (September 2018).

Global Priority Gender Equality

15. Within the framework of the Implementation Plan for the UN Decade of Ocean Science for Sustainable Development and in accordance with the resolution adopted by the IOC Executive Council in July 2018, every effort has been made to ensure that a gender-sensitive approach is applied at all levels, from science to policy, in identifying and addressing ocean science capacity and knowledge needs before and during the Decade. Special attention is being paid to developing synergies between SDG 5 (gender equality) and SDG 14 (Ocean) by focusing on the role of women in ocean science, improving global ocean knowledge, and supporting informed and inclusive decision-making.

Funds mobilized and partnerships established

16. IOC broadened its partnership with the European Commission by launching the MSPGlobal project, a new joint initiative to promote cross-border maritime spatial planning. The success of the IOC-organized 9th Biennial Global Environment Facility (GEF) International Waters Conference in Marrakesh, from 5 to 8 November 2018, ensures the continuity of IOC’s partnership with GEF and UNDP.

17. Communication and outreach efforts have intensified to present the objectives of the Decade and engage various stakeholders though a number of creative means (events, videos, newsletters, website, press releases and social media). The High-Level Scientific Conference (UNESCO Headquarters, 10–11 September 2018), organized in cooperation with the Ocean and Climate Platform and with the support from Canada, and the Ocean session of the UNESCO Partners Forum can be cited as examples of this work. IOC established a partnership with the Velux Foundation (Denmark) with a view to reaching out to the philanthropy sector through an engagement event in the fall of 2019, funded by the Velux Foundation and the Royal Academy of Science and Letters of Denmark.

Major challenges encountered in implementation and remedial actions

18. Overall, the main challenge for the Commission’s small secretariat is the dual task to raise not only extrabudgetary resources necessary to maintain its core operational programmes but also significant additional resources to lead and coordinate the Decade preparation phase. A new approach to fundraising and outreach is being developed, based on highlighting the societal benefits of IOC’s work and demonstrating the return on investment in ocean science and observation.
PART II
DETAILED REPORT BY IOC FUNCTIONS

FUNCTION A: OCEAN RESEARCH
Foster ocean research to strengthen knowledge of ocean and coastal processes and human impact upon them

19. In the reporting period (from June 2017 to present), the Ocean Science Section has continued to coordinate the Ocean Research function of IOC (Function A), with particular view to the priorities of Member States as decided at the 29th session of the IOC Assembly; the need for IOC to respond to the output of the UN Ocean Conference in June 2017; and the need to contribute to the design and implementation to the research element of the UN Decade of Ocean Science for Sustainable Development.

20. IOC has engaged actively in the review of the World Climate Research Programme (WCRP) and contributed to the development of the new WCRP Strategic Plan 2019–2028 (cf. IOC/INF-1375). Close cooperation has been established with the WCRP core project on Climate Variability, Predictability and Change (CLIVAR) in the area of Eastern Boundary Upwelling Systems (EBUS) in collaboration with the Scientific Committee on Oceanic Research (SCOR).

21. EBUS are the most productive marine ecosystems in the world in terms of their contribution to food security and may be undergoing change due to warming and alteration in stratification patterns, changes in upwelling regimes, and potentially changes in their biogeochemical features. Building on the longstanding IOC-Spain/AECID (Spanish Agency for International Development Cooperation) cooperation in the execution of the project “Enhancing oceanography capacities in the Canary Current Large Marine Ecosystem and the growing mobilization of countries from Western Africa, in partnership with the Instituto Español de Oceanografía (IEO), the Ocean Science Section of the IOC Secretariat has designed an ambitious work stream on EBUS, which would contribute directly to SDGs 14, 13 (Climate Change) and 2 (Food). This work stream foresees the following main steps: continuous implementation of the CCLME project, third phase (a workshop on The Effects of Climate Change on the Productivity in the CCLME was held in Santa Cruz de Tenerife, Spain on 18–20 September 2018, and a second workshop will be held in Cabo Verde in the fall of 2019. Both workshops involve experts from seven African countries and Spain; the co-sponsoring of the Summer School on EBUS: Assessing and Understanding their Changes and Predicting their Future, in collaboration with WCRP/CLIVAR, at the International Center for Theoretical Physics (ICTP) in Trieste, Italy from 15 to 21 July 2019; co-sponsoring of the Summer School on EBUS Variability and its Impact on Marine Life and Climate (Dakar, Senegal, 8–19 June 2020), jointly with the SCOR Working Group 155 on EBUS: Diversity, coupled dynamics and sensitivity to climate change; the organization of an international workshop on EBUS in Spain in 2020; and the organization of a first-ever Open Science Conference on EBUS in Lima, Peru in April 2021, jointly with SCOR and WCRP/CLIVAR. Moreover, the IOC Secretariat has held preliminary talks with the Food and Agriculture Organization of the United Nations (FAO) with the goal to design a joint project for consideration by the Global Environment Facility aimed at a comparative diagnosis and management actions relating to status and trends of the main four EBUS (Canary Current, Benguela Current, Humboldt Current and California Current LMEs) and related impacts on food security and sustainable ocean economies.

22. IOC is paving the ground with the WCRP core project on Climate and the Cryosphere (CliC) with regard to science requirements related to Polar Regions in the context of the UN Decade of Ocean Science.

23. An important focus of Function A is research on the effects of human alteration of the carbon cycle and of climate change, as well as mitigation of climate change.
24. IOC convened a major Symposium on the Effects of Climate Change on the World Ocean, the fourth of a series, together with ICES, PICES and FAO, and in collaboration with NOAA. The Symposium, organized by NOAA, was held in Washington D.C., USA from 4 to 8 June 2018, and benefited from the attendance of some 600 participants. The outputs of the Symposium will feed into the scoping process of the UN Decade of Ocean Science.

25. IOC continues to lead in the area of ocean acidification through its active participation in, and support to, the Global Ocean Acidification Observing Network (GOA-ON), as well as participation in other relevant international groups such as the international Ocean Acidification international Reference User Group (OAiRUG). In the reporting period, the Commission hosted two expert group meetings to develop further the methodology for SDG indicator 14.3.1. This methodology is now openly available on the IOC website. The Inter-agency and Expert Group on SDG Indicators (SDG-IAEG) of the UN Statistical Commission agreed on the reclassification of SDG indicator 14.3.1 from Tier III to Tier II, which reflects that the indicator is considered conceptually clear, has an internationally established methodology and that standards are available, but that data are not yet regularly produced by countries. The IOC Ocean Science Section has embarked in the preparation of a manual for the application of the methodology related to SDG indicator 14.3.1 and of a related database hosted at IODE, which will facilitate the regular contribution to data collection and annual reporting to the UN; this activity will be supported financially by the Ocean Policy Research Institute of the Sasakawa Peace Foundation. IOC supported the annual GOA-ON Executive Council meeting in Sopot, Poland, from 28 to 30 May 2018; and co-organized the 4th GOA-ON International Workshop in Hangzhou, China 12–14 April 2019.

26. Thanks to the continuous fruitful collaboration between IOC and the Western Indian Ocean Marine Science Association (WIOMSA), six countries along the Eastern African Coast are now starting to measure ocean acidification on a systematic basis. A kick-off workshop for this activity was co-organized by IOC and WIOMSA in Mombasa, Kenya from 12 to 14 February 2019. During the reporting period, the Ocean Science Section continued to provide the function of the technical secretariat of the GOA-ON, together with the International Atomic Energy Agency (IAEA)).

27. Two IOC expert activities organized in Santa Marta, Colombia supported the development of ocean acidification observation and research capacity in the Caribbean and Latin America: the OAiRUG meeting, in partnership with Invemar and IAEA’s Ocean Acidification International Coordination Centre on 19–21 March 2018, which resulted in the publication of the Regional Ocean Acidification Action Plan for Latin America and the Caribbean. A training “Latin American and Caribbean Regional Symposium on Ocean Acidification” focusing on the newly established methodology for SDG indicator 14.3.1 and related data and metadata requirement was held in Santa Marta, Colombia on 21–24 January 2019 at INVEMAR. The Symposium was organized by IOC, the Ocean Foundation with the support of the US Department of State, the Swedish International Development Agency, and in coordination with GOA-ON and the Latin America Ocean Acidification Network (LAOCA). The Symposium highlighted strategies for building low-cost ocean acidification monitoring systems, techniques for building resilient seafood supply chains (including through technological interventions), and policy frameworks for building economic and social resilience at regional and national scales. It also focused both on existing practices and future options for researching the impacts of ocean acidification on, and the development of adaptation plans for, coral reef ecosystems.

28. The fourth WESTPAC Workshop on Research and Monitoring of the Ecological Impacts of Ocean Acidification on Coral Reef Ecosystems was held on 14–15 December 2017 in Phuket, Thailand.

29. Several of the IOC ocean acidification activities implemented by IOC were possible thanks to extrabudgetary funding provided by Germany.

30. The IOC Working Group to Investigate Climate Change and Global Trends of Phytoplankton in the Oceans (TrendsPO) held its second workshop hosted by the Alfred Wegener institute in
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Bremerhaven, Germany from 4 to 8 December 2017 and a third workshop hosted by the University of California Santa Cruz from 12 to 15 November 2018. Current work focuses on compiling and analyzing long-term time series of phytoplankton. A data plan has been developed in cooperation with IODE/OBIS to facilitate contribution of phytoplankton time series to OBIS and to develop analytical tools for TrendsPO.

31. In the area of coastal blue carbon ecosystems, the Blue Carbon Initiative (BCI), co-sponsored by IOC, the International Union for Conservation of Nature (IUCN) and Conservation International (CI) held its annual meetings in October 2017, in Ibiza, Spain, and in August 2018 in Weihai, China, stressing, in particular, the importance of seagrass ecosystems for the mitigation of climate change. The Commission supported several experts from developing countries in their attendance at these meetings. In addition, the Ocean Science Section co-organized and participated in several side events focusing on Blue Carbon ecosystems and their climate change mitigation potential at the 23rd and 24th sessions of the Conference of the Parties to the United Nations Framework Convention on Climate Change.

32. IOC is addressing the issue of marine geoengineering through the joint sponsorship with IMO and WHO of the GESAMP Working Group on Marine Geoengineering. In March 2019 the Group released its first report which comprehensively examines a wide range of marine geoengineering techniques to remove carbon dioxide from the atmosphere, boost the reflection of incoming solar radiation to space (albedo modification), or in some cases the application of both techniques. Further, the report recommends that a coordinated framework for proposing marine geoengineering activities, submitting supporting evidence and integrating independent expert assessment must be developed; and that a greater expertise on wider societal issues is sought with the aim to establish a knowledge base and provide a subsequent analysis of the major gaps in socio-economics and geopolitics. The sponsoring agencies are currently in the process of defining the future focus of GESAMP on geoengineering and IOC experts networks and Member States will be consulted in this respect.

33. IOCAFIRCA and the Western Indian Ocean Marine Science Association (WIOMSA) have been co-sponsoring the participation of ocean experts in the Climate Outlook Forum for the Greater Horn of Africa (GHACOF) region to enhance the collaboration between climate and ocean scientists in order to improve climate forecasts, as well as mitigating the impacts of climate in the coastal and marine zones. Support was provided for participation of ocean experts in the 47th and 48th sessions of the GHACOF, which were held, respectively, on 21–22 August 2017 in Zanzibar, Tanzania and on 12–13 February 2018 in Mombasa, Kenya.

34. The recently-formed IOC Working Group on Integrated Ocean Carbon Research (IOCR) has constituted a Scientific Steering Committee, made of experts designated by the Global Carbon Project (GCP), the International Ocean Carbon Coordinating Project (IOCCP), the Integrated Marine Biosphere Research project (IMBeR), the Surface Ocean-Lower Surface Atmosphere Study (SOLAS), WCRP/CLIVAR and IOC. The IOCR SSC has initiated the scoping of a comprehensive expert workshop on integrated ocean carbon research, scheduled to take place at IOC headquarters in Paris, France, on 28–30 October 2019. IOC has been invited to contribute to the Research Dialogue of the UNFCCC, to be held in Bonn, Germany on 20 June 2019.

35. The Ocean Science Section of IOC is also active in relation to research efforts related to ocean stressors other than the alteration of the carbon cycle.

36. The IOC Secretariat together with the SCOR Working Group 149 on Changing Ocean Biological Systems: How will biota respond to a changing ocean? developed a policy brief on multiple ocean stressors (cf. IOC/INF-1367) aimed at scoping further joint work of IOC and SCOR in this area.

37. In the area of de-oxygenation, annual meetings of the IOC Global Ocean Oxygen Network expert group (GO2NE) were held in Kiel, Germany from 31 August to 1 September 2018 and at IOC
headquarters in Paris, France on 13–14 June. Recent achievements related to de-oxygenation include a comprehensive IOC summary for policy-makers on de-oxygenation in the ocean (cf. IOC/2018/TS/137); a review article in Science, which has benefited from significant media coverage; and the organization of a major conference on de-oxygenation held at GEOMAR in Kiel, Germany in September 2018. In addition, an Ocean Oxygen Summer School will take place in Xiamen, China, on 2–7 September 2019.

38. IOC has continued to co-lead with UN Environment the GESAMP Working Group 40 on Sources, Fate and Effects of Plastics and Microplastics in the Marine Environment. The second part of the Global Assessment on Plastics has been completed and published as GESAMP Report no. 93 on Sources, Fate and Effects of Microplastics in the Marine Environment: Part 2 of a Global Assessment. The Working Group is now in the third phase of its work, which aims to develop guidelines covering terminology and methodologies for the sampling and analysis of marine macroplastics and microplastics, to be published in early 2019; and to assess the significance of plastics and microplastics as a vector for indigenous and non-indigenous organisms, and make research and policy-relevant recommendations. In the WESTPAC region, microplastics research and monitoring activities were initiated through a first regional workshop held on 20–22 September 2017 in Phuket, Thailand; a side event during the ASEAN Conference on Marine Debris (22–23 November 2017, Phuket, Thailand); and an international microplastics symposium (24–25 April 2017, Shanghai, China).

39. The IOC International Group on Marine Ecological Time Series (IGMETS) produced a first time ever review of quality controlled ecological time series and held a first meeting in November 2018 at IOC headquarters in Paris, France in order to undertake the scoping of a second assessment, to be published in 2020. This activity is instrumental in developing a multidisciplinary, integrated view at trends in ocean changes.

40. In addition to the thematic regional activities reported above, a number of further research activities tailored to the WESTPAC region were initiated and implemented, including: the development of a framework for cooperative studies in the Western Pacific Marginal Seas: Energy and materials exchange between land and open ocean (26 October 2017, Fukuoka, Japan; and 17–18 December 2018, Qingdao, China); the feasibility study on the second Collaborative Study of Kuroshio and adjacent region (CSK-2), with a regional review workshop conducted on 13–17 November 2017 in Qingdao, China and a second one on 23–25 January 2018 in Yokohama, Japan; a regional workshop on Harmful Jellyfish Sampling Protocol and Data Analysis in the Western Pacific (5–7 December 2017, Penang, Malaysia); a course on the application of molecular taxonomy for biodiversity conservation (20–21 January 2018, Seoul, Republic of Korea); and the study on upwelling and its Dynamics in the South China Sea and its Adjacent Areas (7–8 May 2018, Putrajaya, Malaysia).

41. In the area of science capacity, IOC has embarked into the production of the second edition of the Global Ocean Science Report (GOSR) (cf. IOC/INF-1366). GOSR acts as the main means to monitor progress towards the achievement of SDG Target 14.A on ocean science capacity. A renewed Editorial Board for GOSR has been formed and a GOSR Data Portal is being designed in collaboration with IODE, pursuant to the request of the IOC Assembly at its 29th session. IOC Member States were invited to submit national data relevant for the GOSR-II via a web-based GOSR-II questionnaire. The IOC Secretariat together with the GOSR-II Editorial Board and authors of the report are currently processing and analyzing the information received through the questionnaire. A bibliometrics study on science production will also inform the data underpinning GOSR-II. Two meeting of the Editorial Board took place, in the spring of 2018 at IOC headquarters and in May 2019 in Zanzibar, Tanzania, hosted by WOUMSA and benefiting from financial support from the Flanders Marine Institute (VLIZ) and WOUMSA. The Board agreed on detailed intended content and structure of the report, the production timeline and a dedicated communication strategy. The GOSR-II is envisaged to be published in 2020, thus providing the baseline information for the UN Decade of Ocean Science for Sustainable Development. The report will be launched at the second UN Oceans Conference in the second quarter of 2020.
Key Challenges Encountered in Implementation and Remedial Action Taken

42. In several cases, the implementation of the foreseen scientific activities has been hampered by limited data accessibility. Open access to data is not given, for example, in relation to plankton or ocean oxygen data. In some cases, limited data quality control also prevents global assessments of the issues studied. These limitations are being addressed through further close cooperation and interaction with the IODE programme. Several Member States continue suffering from structural lack of capacities in research and systematic observations that hamper their application of standard operating procedures, for example, in relation to the study and monitoring of ocean acidification. Some Member States have also pointed to some difficulties in putting together information on ocean science capacity according to the format of the GOSR-II questionnaire. This challenge has been addressed through the provision of technical assistance by the IOC on a proactive basis.

FUNCTION B: OBSERVING SYSTEM/DATA MANAGEMENT

Maintain, strengthen and integrate global ocean observing, data and information systems

43. The main elements of Function B focus on sustained ocean observing and data management activities, encompassed in the Global Ocean Observing System (GOOS) and regional activities through GOOS Regional Alliances and the IOC Sub-Commissions, the observing programme area of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), and the International Oceanographic Data and Information Exchange (IODE) and its regional activities. These programmes are focused on sustained observing activity and data delivery, with global networks and global approaches. They are the basic infrastructure that enables a significant amount of oceanographic research, and the application of knowledge towards operational information services, and addressing challenges related to climate and the sustainability of marine ecosystem health.

44. The Framework for Ocean Observing (IOC/INF-1284) remains a guiding document for GOOS and the full value chain of observing and data management activities. It emphasizes a systems approach, responding to user requirements, coordinating observations, ensuring data flow to users, regular cycles of evaluation, and improving readiness and capacity to observe. This report on Function B follows that outline.

45. Following feedback from the IOC Executive Council in June 2018, and an open comment period for stakeholders (April–June 2018) and Member States (August–October 2018), GOOS developed and is submitting a Global Ocean Observing System 2030 Strategy for final approval by the IOC Assembly in 2019 (cf. IOC-XXX/2 Annex 7). It has an ambitious vision for a broad ocean observing community in all Member States, and a mission more focused on what the programme can deliver, consistent with the processes in the Framework for Ocean Observing and a clearer expression of the value chain from observations, through data management systems, into scientific assessments and ocean forecast systems, to service and information delivery, and finally into the hands of end-users that can use the information for individual or collective societal benefit. The Strategic Objectives identified have shaped a developing implementation plan and partnership strategy. GOOS innovation actions, both for the observations themselves and in the partnership to improve delivery, are expected to be highlighted in the UN Decade of Ocean Science for Sustainable Development.

46. Other key Strategy objectives include the development of partnerships to improve delivery from GOOS, as well as to increase the responsiveness of the observing system and the visibility and advocacy for sustained observations. Major identified partners include the WMO, UN Environment, Partnership for Observation of the Global Ocean (POGO), GODAE OceanView, GCOS, and IODE. GOOS has initiated work with the OECD on the valuation of ocean observations, starting with support from the AtlantOS project to catalogue valuation studies and identify gaps. GOOS and OECD plan
to continue this work with a focus on best practices in the economic valuation of observations, as a support to Member States in making the critical arguments for sustainability of national funding for observations.

47. Developments in this area will be marked significantly by the proposed creation of a new Joint WMO-IOC Advisory Board, and GOOS taking on a number of observing and forecast system activities of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology after its disbanding in 2020 after a proposed transition period (Agenda item 5.1; cf. IOC-XXX/2 Annex 5). As the major function engaged in cooperation with the World Meteorological Organization (WMO), IOC has worked through a Joint Consultation Group on the Future of JCOMM, co-chaired by IOC vice-chairperson Ariel Troisi, to ensure that these changes, precipitated by a governance reform at WMO, create opportunities for IOC Member States and defend their interests.

Identifying observing and data requirements

Climate

48. Work through the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS), which coordinates a system of observing systems focused on climate requirements, remains the primary way the ocean observing and data system identifies and tracks the needed actions for climate. The IOC gave an invited statement at the opening of the UNFCCC Subsidiary Body for Scientific and Technological advice at COP-23 (Bonn, hosted by the government of Fiji, 6–17 November 2017) on the status of the ocean observing system for climate. The GOOS contribution to GCOS continued with clearer specification of product requirements, and engagement in a Pacific Islands regional workshop focused on needed climate observations (9–12 October 2017, Nadi, Fiji). GCOS and GOOS have worked over this period to develop an operational partnership that highlights ocean observing contributions for climate research, mitigation policy and adaptation, including shared ownership of the Ocean Observations Panel for Climate and Physics (OOPC), and engagement with the Intergovernmental Panel for Climate Change and the UN Framework Convention for Climate Change.

Operational services

49. Operational information and services developed from sustained ocean observations include ocean forecasting system output, longer-term weather and climate predictions, and tsunami and other ocean-related hazard early warnings. The GOOS Physics Panel (OOPC) and the JCOMM Observations Coordination Group both actively participated in updating the WMO rolling review of requirements (largely focused on meteorological applications), and examining how requirements could be implemented in observing networks. The pending creation of a Joint WMO-IOC Advisory Board and closer links from GOOS to its co-sponsor WMO will evolve the link in the value chain from ocean observing activities to operational service delivery related to coastal hazards, long-term weather forecasting, and climate services.

Marine ecosystem health

50. Authors from the GOOS Biology and Ecosystems Panel published a highly-cited peer-reviewed paper in Global Change Biology summarizing the requirements for monitoring biological and ecosystems Essential Ocean Variables (EOVs) to help effectively mitigate or manage the detrimental effects we may be having on the world ocean. The analysis (open access through https://doi.org/10.1111/gcb.14108) reports on work analyzing the impact of monitoring on the stated needs in more than 30 global and regional conventions that touch on ocean ecosystem or biodiversity monitoring, as well as the feasibility from a survey of over 100 global and regional networks observing biological and ecosystems variables. The Panel is shifting from a mode primarily focused on defining requirements to one supporting the development of sustained observing networks for the biological and ecosystems EOVs, focused on capacity development, coordination, and sharing of best practice.
51. While requirements have been expressed in EOVs, it is in fact a structure of requirements that can be identified against information needed to deliver applications and services, key phenomena of the ocean to capture, EOVs, and the capacity of observing platforms and networks to respond, that are the core of improving the integration of GOOS. The three panels of GOOS have been working on harmonization of this, in connection also to regional reviews of observing systems.

**Coordinating observing networks**

52. The JCOMM Observations Coordination Group (OCG) maintained an active workplan focused on delivery against user requirements, delivery of metadata to oceanographic and meteorological data systems, monitoring progress of the system, engaging GOOS Regional Alliances and satellite observing systems, incorporating new technologies, identifying and promoting standards and best practice, and ensuring data flow. Supported in large part from the IOC side as a joint WMO-IOC activity, the OCG meets on an annual basis (14–18 May 2018; 8–11 April 2019), and has engaged new networks such as OceanGliders, HF Radar, and animal tracking networks. The OCG, building on ongoing monitoring of key performance indicators, published a two annual JCOMM Report Cards on the status of the observing system, as well as individual network specification sheets.

53. IOC has a long history of working with Member States and the Argo profiling float programme to manage the float of drifters into waters under national jurisdiction. In 2018, after a period of consultation with Member States, the IOC Executive Council at its 51st session approved Decision EC-LI/4.8 on the "Evolving Capabilities of the Argo Global Array of Profiling Floats," approving the global implementation of six new biogeochemical parameters for Argo floats, through continued use of IOC’s EEZ drift notification guidelines, and an approval framework for additional new parameters for Argo, which allows for a pilot period for a limited period allowing for the scientific evaluation of the results, before bringing the results to an IOC governing body for approval for global implementation. In February 2019, the World Meteorological Organization held a technical workshop on "Enhancing ocean observations and research, and the free exchange of data, to foster services for the safety of life and property" (Geneva, Switzerland, 5–6 February 2019). The workshop resulted in two draft resolutions for consideration by the Eighteenth World Meteorological Congress (to be held 3–14 June 2019), which emphasize: (i) the critical importance and continuing legality of the Voluntary Observing Ship Scheme and operational surface marine meteorological observing platforms for ensuring the provision on a routine basis of adequate marine meteorological observations and data coverage; and (ii) noting the growing importance of sustained global data streams of subsurface ocean observations to improve the skill of operational weather and climate forecasts, decides that WMO work closely with the IOC in order to explore mechanisms that make the highest-impact subsurface ocean data freely available.

54. GOOS, the IODE, ODIP and the AtlantOS projects started cooperative work on evolving, publishing, sustaining and promoting of best practices for observations and data management, hosting a series of workshops, which has evolved from a pilot project into a proposed IODE-GOOS Ocean Best Practices System.

55. Moving from a phase of identifying requirements to stimulating observing networks, the GOOS Biology and Ecosystem Panel co-sponsored a workshop with the Global Coral Reef Monitoring Network (GCRMN, Dar es Salaam, Tanzania, 3–4 November 2017), to start development of an implementation plan for the network and the Coral EOV. This was followed by two other implementation planning workshops, one for the plankton EOV (Santa Cruz, USA, 25–27 June 2018), and one for the macroalgae EOV (together with POGO and IMAS, 24–27 September 2018). The Biology and Ecosystems Panel received a funding award from the PEGASuS 2 call on ocean sustainability sponsored by the US National Center for Ecological Analysis and Synthesis (NCEAS), which aims to design a monitoring network, startign with a baseline map showing status and gaps, tracking the implementation of the biological and ecological component of GOOS focused on monitoring ocean health.
56. The 13 GOOS Regional Alliances form another core of observation implementation activities. The Eighth GOOS Regional Alliances Forum (5–7 September 2017, Singapore) provided an opportunity to discuss the highlights, progress and challenges over the last two years. It agreed on priorities including asset mapping and modeling inventories, cross-GRA pilot projects, and new observing networks. It also agreed to explore stronger engagement of national programmes, and stronger interlinkages between GRAs. The 7th meeting of the GOOS Steering Committee (13–15 June 2018, Santa Marta, Colombia) was preceded by a Regional Workshop for Latin and South America (12 June 2018), which provided some impetus to enlarge the set of individuals and organizations seen to be working towards the objectives of GOOS in the region. GOOS also engaged in the development of a European Ocean Observing System (EOOS), which would build on EuroGOOS by addressing a wider range of societal issues.

57. The evolution of the ocean observing system is the core of two GOOS-related projects: the Tropical Pacific Observing System in 2020 project (TPOS 2020) and the European Commission-funded AtlantOS project, which has produced a vision for an All-Atlantic Ocean Observing System (also called AtlantOS). TPOS 2020 released a draft second report in early 2019, which will be finalized and considered by the IOC Assembly. Both are aiming to leave a legacy basin-scale system in the context of GOOS, and are contributing to an exploration of the governance (using a broad definition of governance that covers both the formal and informal architectures of coordination) of ocean observing systems at a regional level, and their links to global, other regional, and national ocean observing system activities. GOOS has engaged as a sponsor in the organization of the OceanObs’19 Conference (oceanobs19.net, to be held 16–20 September 2019, Honolulu, USA), with a particular eye to using this ocean observing community event to explore good governance of GOOS, the championing of which is a Strategic Objective in the GOOS 2030 Strategy.

58. The development of capacity, both in observations and in the creation of locally-valuable services from a global system, is another key strategic objective of GOOS. It participates in CD activities through the individual actions of networks and the work of the GOOS Biology and Ecosystems Panel and exchanges and projects between GOOS Regional Alliances – and has actively participated in the work of the IOC Group of Experts on Capacity Development in implementing the IOC Capacity Development Strategy.

59. WESTPAC operates two GRAs: NEAR-GOOS (North-East Asian Regional-GOOS) and SEAGOOS (South East Asian Regional-GOOS). NEAR-GOOS operates a data exchange network and database and is implementing a pilot project on a cross basin climate monitoring section, as well as developing Ocean Forecasting Systems with an initial focus on circulation, temperature, wind and waves. SEAGOOS continues its three pilot programmes on: (i) Ocean Forecasting System (OFS); (ii) Monsoon Onset Monitoring and its Social and Ecosystem Impacts (MOMSEI); and (iii) Monitoring of Ecological Impacts of Ocean Acidification on Coral Reef Ecosystems. This last project finalized Standard Operating Procedures now implemented by a number of WESTPAC Member States. SEAGOOS launched on 10 December 2018 the new version of its ocean forecasting system, providing 5-day forecasting products and downloadable archived data for surface wave height, wave period, sea level, three-dimensional ocean current, sea temperature and salinity.

60. IOCARIBE-GOOS participated actively in cross-GRA activities. IOCARIBE continues active work in developing a partnership to improve predictability of the Loop Current in the Gulf of Mexico, to implement glider observations in waters of the the Dominican Republic as part of a wider Caribbean project to improve hurricane forecasting, to update the Caribbean Marine Atlas, and with WMO on a Coastal Inundation Forecasting Demonstration Project for the Caribbean (CIFDP-C), with a pilot for the Dominican Republic and Haiti. IOCARIBE and its GOOS Regional Alliance IOCARIBE-GOOS in association with GEO Blue Planet, UNDP Barbados and the OECS have outlined a pilot project to support an integrated approach to monitoring concentrations of Sargassum weed and oil spills – both significant regional water-borne threats. IOCARIBE is also engaging in the development of an All-Atlantic Ocean Observing System emerging as a legacy of the AtlantOS project.
61. IOCAFRICA activities in observing systems have leveraged the IIOE-2, and in particular the opportunities provided by joint research cruises undertaken by the South African oceanographic research vessel, the SA Agulhas II on 17 October–3 November 2017 and on 10 June–13 July 2018. The research cruises provided opportunity for oceanographic surveys and training of the coasts of South Africa, Mozambique, Madagascar, Tanzania and Comoros with the participation of researchers and students from at least 10 Member States from the region. A special session at the Western Indian Ocean Marine Science Association (WIOMSA) symposium (30 October–4 November 2017, Dar es Salaam, Tanzania) highlighted the need to develop capacity for data assimilation in the region, the possible use of satellite data for areas beyond the ship sampling transects, and the need to clearly define the products that the region should develop in the framework of IIOE-2.

62. The Second International Indian Ocean Expedition (IIOE-2) continued to build its ocean (and coupled climate) research portfolio, aligning strongly with and receiving input from the alliances of IORP, SIBER, IOGOOS and IRF\(^1\). Strong linkages have been established with IOC regional subsidiary bodies IOCAFRICA, WESTPAC, IOCINDIO and UNESCO Category-2 Centres based in Iran and India. Progress has responded well to the IIOE-2 Science Plan. Communications on IIOE-2 science continued via the IIOE-2 website (hosted by the IIOE-2 Indian Joint Project Office), involving monthly newsletters and 6-monthly editions of the *Indian Ocean Bubble*-2. The Data and Information management Plan for IIOE-2 was finalized with the support of IODE Co-Chair Cyndy Chandler, underpinned by a formative workshop at the 2\(^{nd}\) IIOE-2 Steering Committee (March 2018, leading to a draft Plan that was then finalized). In March 2019 the IIOE-2's full Steering Committee had its third annual meeting in Port Elizabeth, South Africa (co-hosted by the IIOE-2 JPO and Nelson Mandela University). That meeting highlighted about 30 major research projects 'endorsed' under IIOE-2. The IIOE-2 community has agreed to advocate for a continuance of IIOE-2 into the next decade, in light of: the IIOE-2's strength of operation and achievements; its clear relevancy for the mutual interests of its three principal sponsors (IOC, SCOR and IOGOOS) and wider stakeholder constituency; more planned prospective research initiatives (into the next decade); and the contribution that an extended IIOE-2 would make to the UN Decade of Ocean Science for Sustainable Development.

63. IOCINDIO developed a strong partnership with IIOE-2. IOCINDIO organised workshops in the context of the IIOE-2 International Indian Ocean Science Conferences respectively in Jakarta, Indonesia, 18–23 March 2018 and in South Africa at the Nelson Mandela University in Port Elizabeth, 11–15 March 2019. These workshops helped to gain the engagement of additional Member States in the revitalisation process of IOCINDIO while also reinforcing cooperation with the IIOE-2.

### Data management

64. IODE published the [IOC Strategic Plan for Data and Information Management (2017–2021)](https://www.ioc-unesco.org/iodex/iod战略计划2017-2021) and the [IOC Communication and Outreach Strategy for Data and Information Management](https://www.ioc-unesco.org/iodex/COM与OutreachStrategy), [IOC Manuals and Guides, 77 & 79](https://www.ioc-unesco.org/iodex/ManualsGuides7779). The World Ocean Database (WOD), maintained by the NOAA National Centers for Environmental Information (NCEI), is the world’s largest collection of ocean data available internationally without restriction. WOD was first released in 1994 but established as an IODE project in 2000. A mirror copy has been established in January 2018 at the IOC Project Office for IODE in Ostend, Belgium.

65. In order to enhance the role of marine information management IODE at its 25\(^{th}\) session adopted the concept of “IODE Associate Information Units” (AIUs), and an application form and

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\(^1\) IORP = Indian Ocean Region Panel of IOCGOOS / CLIVAR; SIBER = Sustained Indian Ocean Biogeochemistry and Research of IOGOOS/IMBER; IOGOOS = Indian Ocean Global Ocean Observing System (a GOOS Regional Alliance); IRF = Indian Ocean Observing System (IndOOS) Resources Forum of IOGOOS
associated review criteria are now available. By end of February 2019 three marine libraries have joined the IODE network as AIU.

66. A new Memorandum of Understanding (MoU) has been signed between UNESCO/IOC and the Flanders Marine Institute (VLIZ) for the period 2017–31/12/2021, securing continued support to the IOC Project Office for IODE, Ostend, Belgium, by the Government of Flanders (Kingdom of Belgium).

67. IODE is continuing and further developing its collaboration with, and support of, other IOC programmes and activities, including the GOSR, HAB, and SDG 14.3.1; as well as more broadly the implementation of the IOC Capacity Development Strategy through its OceanTeacher Global Academy project.

68. The First Session of the Intersessional Working Group to Develop a Concept Paper for an Ocean Data and Information System (ODIS, 5–8 March 2018, Ostend, Belgium) decided to pursue a federated approach leveraging connections between existing systems, to improve semantic and technical interoperability between systems, and to connect data providers having limited capacity to established repositories for securing and making data accessible. The initial output will be a register of known marine data and information sources, including discovery and technical level metadata that will support federated access across these systems in the future. Over time additional sources will be added that are aligned with the FAIR Data Principles, a set of guiding principles to make data Findable, Accessible, Interoperable, and Re-usable (FAIR).

69. Since May 2017 (until 9 April 2018), the Ocean Biogeographic Information System (OBIS) grew with 269 new datasets, adding 7,700 new species and 3.1 million observations resulting in a total of 50.9 million records of 118,000 marine species. Two new national OBIS nodes were established, one in Colombia (hosted by INVEMAR) and one in the UK (hosted by the MBA). The OBIS secretariat is supporting the implementation of the OBIS-ENV-DATA standard through the development of new QC tools, available as webservices and as an R package (https://github.com/iobis/obistools).

70. OBIS is undergoing a major reengineering of its platform (OBIS2.0) which is urgently needed to drive new innovations in science and technology, and to meet the increasing demands for services from global drivers (such as GOOS, GEO BON, CBD, ISA, WOA and IPBES), as well as support the regional focus of several OBIS Nodes (e.g. USA/OBIS, Europe/EMODnet).

71. The information collected on oceanographic cruises that have been undertaken in the Large Marine Ecosystem (LME) regions around Africa will be incorporated in the African node of the Ocean Data Portal that is currently being developed under the coordination of IOCAFRICA.

72. IODE launched the Ocean Data and Information System Catalogue of Sources (ODISCat) (available through http://catalogue.odis.org). The ODIS "Catalogue of Sources" aims to be an online browsable and searchable catalogue of existing ocean related web-based sources/systems of data and information as well as products and services. It will also provide information on products and visualize the landscape (entities and their connections) of ocean data and information sources. It currently welcomes 16 different types of resources. By end of February 2019, 345 online sources have been described in the catalogue. ODISCat is the first product developed within the context of ODIS and will facilitate the further deployment of the system based on existing data and information.

73. The 25th Session of the IODE Committee was held in Tokyo, Japan on 20–22 February 2019 (cf. IOC/IODE-XXV/3s). The session was preceded by a two-day scientific conference which welcomed 150 participants from 40 countries. The 35 presentations (which were recorded and available online at http://www.iode.org/iode25_sciconf) focused on (i) the UN Decade, (ii) how IODE is collaborating in ongoing major initiatives and activities that may contribute to the UN Decade, as well as (iii) regional developments, (iv) capacity development, (v) emerging opportunities for the
future of IODE, including (vi) cooperation with partners. In order to maximize accessibility to the Conference all sessions were live-streamed.

74. The conference concluded with the recommendation that it is critical for IODE to be further strengthened and expanded for it is to play an essential role in supporting the flow from data to information to knowledge. The oceanographic community needs to build a global ocean forecasting system delivering society relevant services, by focusing on managing the data streams of essential ocean variables, both in the climate, operational services and ocean health space. To realize this, IODE and GOOS will need to continue their strong partnership and engage with regional bodies and stakeholders including the private sector. Important steps have been taken by the development of a prototype global Ocean Data and Information System. Future efforts will be in further improving the harmonization of data and metadata standards, developing common vocabularies and promoting and providing training in best practices. The international community is looking to IODE to facilitate and coordinate this process under its intergovernmental mandate. Two special highlights of the conference were (i) the keynote talk by Professor Toshio Yamagata, professor emeritus of the University of Tokyo on the exceptional history of contributions to the field of oceanography by Japan, and (ii) the very first lecture in the Fred Grassle Memorial Lecture Series presented by Dr Yoshihisa Shirayama of JAMSTEC.

75. The IODE Committee Session, as did the scientific conference, specifically addressed the way IODE will be able to contribute to the UN Decade. The IODE Committee recommended to the IOC to include, as part of preparatory process, the formulation of common guidelines/principles on flow, discovery, access, and re/use of data collected during the decade. The IODE Committee adopted a recommendation on the “Establishment of an inter-sessional working group to propose a strategy on ocean data and information stewardship for the UN ocean Decade (IWG-SODIS)” in this regard. The Committee also recommended the IOC Assembly to request the IOC Secretariat to explore through UN-Oceans the interest of relevant UN entities to develop a joint data and information system under the Decade and to start assessing respective data and information policies and identify relevant data and information repositories that may contribute to such system. IODE-XXV also established the IODE/GOOS Ocean Best Practices System project (OBPS) which long-term objective is to provide the ocean research, observing and application communities with a mechanism to discover, review, agree upon, adopt and support the widest possible dissemination of ocean best practices.

76. IODE continues to operate mainly through extra-budgetary support (staff and operational budget). For several of these these projects and staff funding will end by December 2019. Mobilizing funds for the continued operation of the IODE Secretariat beyond 2019, especially taking into account the additional expectations from the UN Decade, will be a priority.

Engaging with users of observations and developing information products

77. The sustained observing and data management systems are user-driven, and engagement with representative user communities, such as ocean forecasting systems, is an important part of evaluation and advocacy. GOOS has re-engaged with the GODAE OceanView ocean forecasting system development activity through its Physics Panel and directly in a partnership development process.


79. GOOS, JCOMM, and OBIS are operating at present with a distributed and majority extrabudgetary-funded staff to support all three GOOS Panels, the technical coordination and metadata activity of the global observing networks at JCOMMOPS, and the development and maintenance of the OBIS platform. For many of these extrabudgetary staff members, project funding
expires in 2019. These have been identified as priorities for fundraising, focusing on the outputs of the projects.

**Key Challenges Encountered in Implementation and Remedial Action Taken**

80. Much of the distributed office supporting the Global Ocean Observing System is outside of IOC/UNESCO HQ and supported by volatile in-kind or voluntary contributions since the withdrawal of the US financial support. The staff has funding horizons supported by projects ending in 2019, and so fundraising to support the essential coordination functions of GOOS and JCOMMOPS beyond mid-2019 is important, with an increasing expectation of co-funding for sustained activities from IOC. With these limited resources, the balance of ‘inward’ activity connecting to the core ocean observing community and helping them on coordination and best practices, versus ‘outward’ partnership-building, communication and advocacy activity is difficult to sustain. At the regional level, the importance of nurturing more partnerships between IOC activities and universities and science associations and networks has been identified, as well as developing partnerships with industry.

81. GOOS staff have engaged in the G7 Future of Oceans and Seas as a way of increasing voluntary contributions. Every effort is put into expanding the resource base as the only way to address both broad objectives of inwards coordination and outwards engagement.

82. Lack of national coordination regarding coastal and marine matters hampers the establishment of national data and information management facilities at the national level.

83. An outreach campaign is developed to increase the awareness of Member States of the importance of national ocean data and information management expertise.

84. Regarding IODE, out of the 10 staff (9.5 FTE) currently working for IODE (9 at the IOC Project Office for IODE), only two are employed on UNESCO regular programme positions, 3.5 FTEs are seconded by the Flanders Marine Institute (funded by the Government of Flanders, Kingdom of Belgium) and three are project appointments or consultants. While the role of IODE as a cross-cutting programme supporting other IOC programmes in data and information management increases, staffing is insufficient to respond to the growing needs.

85. While the data and information made available by an increasing number of stakeholders is increasing rapidly, the IODE network has difficulties mapping and monitoring the data and information flow, resulting in duplicates, near-duplicates and loss of provenance metadata. This will be a priority to be addressed by ODIS, the Ocean Data and Information System. Closer cooperation with the real-time ocean observing community (GOOS, JCOMM) is also a priority for IODE.

**FUNCTION C: EARLY WARNING AND SERVICES**

*Develop early warning systems and preparedness to mitigate the risks of tsunamis and ocean-related hazards*

86. Function C centres around four main programmatic components: (i) the global Tsunami Warning System; (ii) the Global Sea Level Observing System (GLOSS); (iii) Operational Ocean Forecast Systems services under JCOMM; and (iv) the Harmful Algal Bloom programme.

**Tsunami Warning Systems**

87. The main elements of the Tsunami Programme focus on: (i) secretariat support to the four Intergovernmental Coordination Groups (ICG) and respective technical working groups and task teams under the four regional Tsunami Warning and Mitigation Systems in the Caribbean (CARIBE-EWS), Indian Ocean (IOTWMS), Pacific (PTWS) and North-East Atlantic, Mediterranean and
connected seas (NEAMTWS) as well as the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) which address inter-ICG and cross-cutting coordination and harmonization; (ii) preparedness and awareness courses and workshops; and (iii) enabling research and policy development.

Support for the intergovernmental coordination of regionally harmonized tsunami warning systems

88. Governance meetings and technical working group meetings set the strategic directions and facilitate the ongoing development, guidance and harmonization of the four regional tsunami warnings systems.

89. The ICG/CARIBE EWS held two regular ICG meetings, on April 24–27, 2018 (Willemstad, Curacao) and 8–11 April 2019 (Punta Leona, Costa Rica), and one Officers Meeting on 13–14 November 2017 (Santo Domingo, Dominican Republic).

90. In the IOTWMS, two integrated meetings were organised on 4–17 September 2017 hosted by Indonesia at BMKG, Jakarta and 26 June–14 July 2018 hosted by India at INCOIS, Hyderabad. Integrated meetings have proven to be highly effective in pursuing intersessional workplans of the ICG and ensuring wider engagement of Member States in the working group/task team activities and trainings/workshops, as well as optimising resources. ICG/IOTWMS-XII took place in Kish Island, Iran, 9–12 March 2019.


92. PTWS held one Steering Committee and back-to-back Working Group/Task Teams meetings on 4–8 June 2018 (Honolulu, USA) and one regular biannual meeting on 2–6 April 2019 near Managua, Nicaragua.

National and sub-regional Tsunami Warning system developments

93. The active investments of nations and/or their concerted actions contribute substantially to the development of the Tsunami Warning Systems.

94. The Portuguese National Tsunami Warning Centre was formally inaugurated on 25 November 2017 following the ICG/NEAMTWS meeting. The Centre started to act as a candidate Tsunami Service Provider in January 2018. In February 2019 the Centre requested to be accredited as a NEAM Tsunami Service Provider.

95. The South China Sea Tsunami Advisory Centre (SCSTAC) hosted by China was formally inaugurated on 8 May 2018. The Seventh Meeting of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region (WG-SCS) took place in March 2018, in Hanoi, Vietnam. The meeting produced a draft Recommendation for the ICG/PTWS-XXVIII concerning transition to full operation of the SCSTAC. The Eighth Meeting of the WG-SCS was held on 4–6 March 2019 in Jakarta, Indonesia hosted by BMKG.

96. The Fifth ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation for Pacific Island Countries and Territories (PICTs) and PTWS Working Group 2 Task Team on Seismic Data Sharing in South West Pacific, was organized in August 2017 in Honiara, Solomon Islands. The Sixth WG-PICTs took place on 8 March 2019 in Noumea, New Caledonia – France.

97. A meeting of the ICG/IOTWMS sub-regional working group for the North West Indian Ocean region was held on 9 July 2018 in Hyderabad, India. Further, an expert consultation of scientific tsunami hazard assessment of the Makran Subduction Zone (MSZ) was organised on 8 March 2019 back to back with the ICG/IOTWMS-XII session in Iran. The Expert Consultation was successful in identifying current status, gaps and future priorities in the MSZ with reference to (i) Optimal observing
networks for effective tsunami warning, (ii) Seismicity and Credible Maximum Earthquake Magnitude, (iii) Tsunami Hazard Assessment, (iv) Potential impact of Seismic and Secondary non-seismic effects on tsunami generation in MSZ including Red Sea and Persian Gulf and (v) Last-mile. Based on recommendations of the Expert Consultation, the ICG/IOTWMS-XII established two new Task Teams on “Tsunami Preparedness for a near-field Tsunami Hazard” and “Scientific Tsunami Hazard Assessment of the Makran Subduction Zone”, whose activities will be closely aligned to an upcoming project on “Strengthening Tsunami Early Warning in the North West Indian Ocean” being funded though the ESCAP multi-donor trust fund for tsunami, disaster and climate preparedness. Planned activities will enhance collective understanding of the Makran tsunami hazard, and assist Member States to assess their tsunami risk, strengthen national warning systems, enhance warning chains, develop evacuation plans, build emergency response capacity and raise community awareness, preparedness and resilience with specific emphasis on a near-field tsunami threat.

98. As part of the Tuvalu National Adaptation Programme of Action (NAPA), UNDP funded installation of portable Iridium satellite terminals (so called Chatty Beetle) on 8 Tuvalu islands. The terminals allow for text-based alerts and messaging in remote locations, where communication options are limited. Tuvalu NTWC and NDMO tested the terminals during the PacWave18 exercise. In 2018, Fiji installed a 13-siren network within the capital city and the Suva Peninsula.

Tsunami Exercises

99. Tsunami exercises and drills help to increase tsunami preparedness and awareness of coastal communities. Regular exercises are essential to maintain operational readiness of response agencies and exercises test communications, review agency standard operating procedures, and promote emergency preparedness.

100. Tsunami exercise were organized in the Caribbean region (15 March 2018 and 14 March 2019), Indian Ocean region (4–5 September 2018), NE Atlantic and Mediterranean (31 October–3 November 2017), and in the Pacific (1 September–30 November 2018).

101. With support from the Caribbean Tsunami Information Center and the US hosted Caribbean Tsunami Warning Programme (CTWP), the CaribeWave 2018 Exercise mobilized ~0.5 million of participants that contributed once again to increase awareness and preparedness for tsunamis in the Caribbean.

102. CaribeWave 2019 took place on 14 March 2019, with the Exercise Handbook finalised in November 2018 and the trilingual webinars convened in January–February 2019. Two scenarios have been prepared and for the first time a volcano scenario is used which presents an opportunity to evaluate the type of products PTWC could issue for such an event as well as the corresponding national and local standard operation procedures for such an event.

103. Exercise Indian Ocean Wave 18 (IOWave18) was conducted on 4–5 September 2018. All 24 active Member States participated in the exercise which included community evacuation drills, involving around 116,000 participants in India, Indonesia, Iran, Kenya, Mauritius, Oman, Pakistan, Seychelles, Sri Lanka, Tanzania and Thailand. This is a marked increase compared to 60,000 participants which did community evacuations during IOWave16. Most importantly, at least 6 communities in Odisha province of India and 1 community in Oman are reported to have evaluated their community preparedness against Indian Ocean Tsunami Ready (IOTR) indicators, with an intent of achieving Tsunami Ready recognition in the near future. A public webpage developed by TSP-Australia to display the summary of national tsunami warnings issued by countries in the Indian Ocean was launched during the exercise. A post-IOWave18 workshop was conducted on 15–17 November 2018 in Jakarta, Indonesia to share lessons learnt from the community evacuations and IOTR piloting.
104. NeamWave 2017 was the third exercise for the region. Twenty countries and the European Union Civil Protection Mechanism (ERCC) participated in the exercise and the evaluation report has been published with recommendations for future exercises.

105. The PacWave18 exercise was conducted in 27 countries under ICG/PTWS from 13 October–20 December 2018. Twenty-five countries have fully submitted their online evaluation.

106. Outside the scope of the regional tsunami warning systems, community and national exercises are carried out.

107. With the support of the UNDP regional project “Strengthening school preparedness for tsunami in Asia and the Pacific”, targeted schools in Fiji, PNG, Samoa, Solomon Islands, Vanuatu and Tonga participated in tsunami evacuation exercises in collaboration with their respective NTWC and NDMO.

108. Fiji has conducted a series of Tsunami Evacuation exercises to evaluate the 2017 National Tsunami Response Plan and Tsunami early warning SOP. The NTWC and NDMO have carried out drills with schools, government, UN Agencies and Universities.

109. Israel carried out an earthquake and tsunami exercise on 12 March 2019 focusing on schools along Israel’s Mediterranean coast with about 10,000 students participating.

**Strengthening the work of regional Tsunami Information Centres**

110. Tsunamis happen infrequently and community awareness of tsunami risk and preparedness is essential. In each of the four regional tsunami warning systems Tsunami Information Centres have been established. The role of TICs are to provide awareness information on tsunami and other sea-level related hazards to the general public and communities. The Tsunami Information Centres also facilitate the Tsunami Ready—a UNESCO-IOC pilot community recognition programme that promotes tsunami hazard preparedness as an active collaboration of national and local emergency management agencies, community leaders and the public.

111. The International Tsunami Information Center (ITIC) hosted by the NOAA National Weather Service of United States continued to play a key role in the reinforcement of capacities of key stakeholders in the Pacific Tsunami Warning and Mitigation System (PTWS), through the co-organisation of several trainings together with in the framework of the IOC Tsunami programme.

112. With financial support from the Kingdom of Netherlands, the Caribbean Tsunami Information Center hosted the Regional Training Workshop on Pacific Tsunami Warning Center (PTWC) Enhanced Tsunami Products for ICG/CARIBE-EWS in October 2017 in Cartagena, Colombia.

113. Within the framework of the Regional Response Mechanism of the Caribbean Disaster Emergency Management Agency (CDEMA) and the United Nations Disaster Assessment and Coordination (UNDAC), UNESCO and its IOC-led Caribbean Tsunami Information Center (CTIC) supported the regional response to Hurricanes *Irma* and *Maria* that impacted the Caribbean region in September 2017. In addition to facilitating internal UNESCO coordination, this involvement also allowed for an assessment of the capabilities of the Tsunami Ready (TR) Programme within the impacted Member States of Anguilla and the British Virgin Islands. The assessment confirmed the utility of the TR Programme as a multi-hazard tool and identified areas for additional support (signage and emergency equipment) due to the hurricane impacts.

114. A Preliminary After Action Review of the January 2018 Honduras Earthquake was conducted under CTIC coordination which sought to assess the response of ICG/CARIBE-EWS Member States and identify possible areas of support to enhance Member State capabilities. This assessment revealed the need for continued support to Member States in the analysis of tsunami threat messages and the development of national tsunami protocols and SOPs. The results also indicated
strong support for and interest in the implementation of the ICG/CARIBE-EWS TR Programme by non-pilot States.

115. Within the CARIBE-EWS key activities were implemented to enhance Member State capacities in the development and operations of their tsunami early warning systems. UNESCO/IOC and its CTIC provided continued support to the US NOAA Caribbean Tsunami Warning Program (CTWP) and Member States in the implementation of ICG/CARIBE-EWS Community Based Tsunami Performance Pilot Programme (Tsunami Ready) which resulted in the recognition of the pilot communities of St. Patrick, Grenada and Fort Liberte, Haiti being recognised in September 2018. Some twelve (12) additional pilots are currently being supported as part of various UNESCO/IOC and CTWP implementation initiatives.

116. The Indian Ocean Tsunami Information Centre (IOTIC) supported under the BMKG-IOC partnership continued to play a key role in co-organisation of capacity development activities including IOTR piloting, trainings on Standard Operating Procedures (SOPs) and Tsunami Evacuation Maps, Plans and Procedures (TEMPP), etc. Following the 28 September 2018 Palu tsunami, the IOTIC coordinated International post-Tsunami Survey Teams (ITST) by 7 teams comprising 87 scientists from 18 countries and Indonesia. IOTIC was also part of a rapid assessment team that surveyed the tsunami impacted areas in Palu and the Anak Krakatau tsunami due to volcanic eruption of 23 December 2018.

117. A strategy for NEAMTIC was developed to guide the future development of NEAMTIC. The strategy provides a proposed action plan with three phase implementation: (i) NEAMTIC website maintenance and updates; (ii) redevelopment of NEAMTIC website; and (iii) development of NEAMTIC as a training centre/platform. Phases 1 and 2 have been started, while phase 3 will depend on additional funding.

World Tsunami Awareness Day

118. On 16 October 2018, UNISDR and IOC convened a high-level panel event on Reducing Human and Economic Impacts from Tsunamis at UNESCO as a contribution to the 3rd edition of World Tsunami Awareness Day (commemorated on 5 November 2018). The meeting exemplified real impacts of tsunamis for SIDS and their coastal tourism sector, and underscored the need for continued community preparedness to avoid complacency.

Targeted capacity development and technical assistance

119. Human and national capacity to deal with tsunamis are still unevenly spread among nations. Since its start the Tsunami programme has contained a strong capacity development component. The aim of these activities is to enable Member States to understand its risk and know ways in which they can mitigate the hazard, provide warning to its populations in a timely manner, and be able to carry out awareness and preparedness activities to sustain knowledge and ability-to-respond across generations.

120. The ICG/IOTWMS undertook several focussed capacity development activities including SOP and TEMPP trainings, with a total of 7 trainings/workshops conducted in the inter-sessional period. SOP trainings covered 21 countries and TEMPP trainings covered 22 countries. These trainings directly benefited Member States by improving in-country procedures for end-to-end tsunami warning, participation in IOWave18 and enhancing community preparedness through the piloting of the Indian Ocean Tsunami Ready programme. An online survey on the capacity Assessment of Tsunami Preparedness of the IOTWMS Member States was undertaken leading to the development of IOTWMS Status Report. The IOTWMS continues to conduct biannual communications tests in June and December each year and the participation rate is generally about 85–90% of active National Tsunami Warning Centres.
121. In the framework of the last phase of the European Union funded DIPECHO project “Building resilient communities and integrated Early Warning Systems for tsunamis and other ocean related hazards in Central America” (2016–2017), trainings and workshops were organized between July and November 2017 in Guatemala, Nicaragua, Honduras and El Salvador which included development and/or reinforcement of tsunami Standard Operating Procedures, community level tsunami drills and elaboration of tsunami educational materials jointly with their ministries of Education. This contributed to better prepare participating national agencies and beneficiary communities towards coastal hazards in particular tsunami. A second phase for this project, also supporting Costa Rica and Panama, is ongoing (2018–2019) and is targeting the Tsunami Ready pilot recognition for 10 Central America communities.

122. Training courses that address the Caribbean seismic and sea-level observing networks were carried out in August 2017 and February 2018. These courses contribute to network sustainability and reinforce data exchange for tsunami warning purposes in the region.

123. UNESCO/IOC has been successful in securing funding from ECHO to implement the “Strengthening capacities of early warning and response for tsunamis and other coastal hazards in the Caribbean” Project from July 2018. This 18-month initiative seeks to develop a sub-regional tsunami response coordination plan for CDEMA Participating States focusing on the CDEMA-led Regional Response Mechanism (RRM). Under this project initiative each pilot state will also benefit from a national tsunami response protocol and SOPs with non-pilot States benefiting from a generic protocol which would facilitate adaptation to the country-specific situation. Five (5) new TR communities are also expected to be recognised through this initiative.

124. A training course was organised in July 2017 in Suva Fiji for SIDS on Improving Tsunami Warning and Response using PTWS Enhanced Products. A training course was organized in April 2018 in Tarawa, Kiribati for SIDs on Improving Tsunami Warning and Response using PTWC Enhanced Products and standard operating procedure.

125. The 2018 annual ITP-ITIC-IOC training course (1–10 August) was for the first time organised outside Hawaii. The course was hosted by the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) in Chile, and with attendance of students and experts from the Caribbean, Pacific and Europe. The training covered earthquake seismology and tsunami hazard assessment for planning and warning decision making through emergency response chain all the way to the public.

126. IOC has organized information meetings on NEAMTWS in: (i) Tunis in collaboration with the Arab League Educational Cultural and Scientific Organization (ALESCO) and Institut National de la Météorologie (13–14 September 2017); (ii) in Madrid in collaboration with Instituto Español de Oceanografía and the Protección Civil y Emergencias (26–27 September 2017); and in Rabat in collaboration with the Islamic Education, Scientific, and Cultural Organization (ISESCO), the UNESCO Rabat Office and the UNESCO Science Sector (12–13 November 2018).

Support for enabling research and policy development

127. Ongoing improvements of Tsunami warning systems and mitigation efforts are important. They contribute to sustain the system, reduce costs and uncertainty, and maintain public trust.

128. IOC organised the symposium on Advances in Tsunami Warning to Enhance Community Responses on 12–14 February 2018 at UNESCO Paris. The Symposium examined lessons learnt from past events and recent efforts in further developing tsunami warning and mitigation systems to enable enhanced community responses. The Symposium identified future needs and suggested developments within the following areas: (i) Detection and Warning; (ii) Disaster Management; (iii) Community Awareness and Preparedness; (iv) National Initiatives; and (v) International Initiatives. 105 participants from 28 countries attended the event.
129. The CARIBE-EWS convened the inaugural meeting of the Group of Experts on Coastal Hazards in November 2018. This meeting leveraged an approach by regional and national stakeholders towards the formal integration of other coastal hazards within the ICG/CARIBE-EWS. Key outputs include a characterization of coastal threats, a list of priority coastal threats, a status of the coastal hazards EWS for the Caribbean and Adjacent Regions and a draft outline of the strategic plan and timetable including the development of the implementation plan to guide the integration of other coastal hazards within the ICG/CARIBE-EWS. A Chairperson and Vice-Chairperson have also been selected to guide the work of the Group.

Global Sea-Level Observing System (GLOSS)

130. Sea-level observations provide information on a wide spectrum of oceanographic processes. Field observations of sea level also are needed to monitor and understand global sea level rise, as well as interannual to decadal sea-level variations, which provide insight into ocean circulation changes on climate time scales. In addition, sea-level observations are used to examine extreme events associated with tsunamis, storm surges, and other factors leading to short-term coastal inundation. Given the multi-dimensional, multi-purpose nature of tide gauge observations, there is considerable benefit to be gained from well-designed sea-level observing networks that support a broad research and operational user base. The Global Sea-Level Observing System (GLOSS) provide such a service. GLOSS provides oversight and coordination for global and regional sea-level networks in support of, and with direction from, the oceanographic and climate research communities.

131. GLOSS Group of Experts meetings have been organized on 8–9 July 2017 (New York, USA), and on 11–13 April 2019 (Busan, Republic of Korea). The GLOSS GE coordinates and reviews observation network and programmatic and strategic activities. The GLOSS observation network and four GLOSS data centres rely on observation contributions from a very large number of countries (>70). A conservative estimate is that the four GLOSS data centres underpin at least 200 papers in 2017. Aside from the publications other products are generated based on the data availability. As an example, the IOC Sea Level Station Monitoring Facility tracks some 858 active sea-level stations from more than 150 institutions, and the web-site had 2 billion web-hits in 2018 and during Tsunami events usage increases by 400%.

132. To address existing challenges in describing and predicting regional sea-level changes, and to discuss intrinsic uncertainties, the WCRP Grand Challenge on Regional Sea Level Change and Coastal Impacts, jointly with the IOC, organized an international conference on sea level research. This conference followed 11 years after the first WCRP sea level conference (Paris, 2006), and three years after the last Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). It provided a comprehensive summary of the state of worldwide climate-related large-scale sea level research. A conference statement was issued that details findings, current knowledge and calls for supporting actions with respect to observations, science and policy development. The five-day conference was held at Columbia University in New York. More than 350 Participants from 42 nations attended the event.

133. IOC organized an international workshop on sea-level measurements in hostile conditions was held on 13–15 March 2018 at the N.N. Zubov State Oceanographic Institute (SOI) of Roshydromet, Moscow, Russian Federation. Sea-level observations are needed for a number of scientific and practical applications. Such observations often need to be carried out in what can be characterized as harsh or hostile environmental conditions. A significant part of the seas on the planet are covered with ice on either a permanent or seasonal basis. Many of them, in addition, often experience storms, high waves and/or high tides. Biological/environmental/logistic factors as well as increasing requirements and expectations for performance can add to the challenges of operating a sea-level measurement station in these conditions. The workshop addressed the impacts of extreme events, such major storms and high wave conditions. The workshop discussed new measurement systems and instrument protection technologies, together with methods for sustainable transmission of observational data. Thirty-nine (39) participants from 10 countries attended the event.
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134. IOCINDIO organized a scientific, technical and institutional innovations workshop in order to assist Member States in the region to build their national and regional Framework and Guidelines for Coastal Vulnerability Assessment in the context of Sea-level rise and Storm Surges, with the kind support of the newly established International Training Centre for operational oceanography under the auspices of UNESCO (Category 2) at the Indian National Centre for Ocean Information Services (INCOIS) in Hyderabad, (27–31 May 2019).

JCOMM Services

135. The JCOMM Expert Team on Operational Ocean Forecast Systems was reconstituted following JCOMM-5 (November 2017), and is preparing a workplan focused on supporting best practices in forecasting systems and the services they enable, including a focus on supporting capacity development. In advice from the JCOMM Management Committee which met in November 2018, it is foreseen that under the reorganization of ongoing work after the reform of WMO structures, that GOOS be a focus of ocean forecast system activity.

Harmful Algal Bloom programme

136. Impacts of harmful algae on aquaculture, food safety, fisheries, tourism and other ecosystem services are permanent and widespread and intensify as the exploitation of the coastal seas intensifies. Routine monitoring and appropriate management plans can to a large degree prevent or minimize impacts. IOC priorities and actions on Harmful Algal Blooms are since 1992 set by the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) and the work programme is implemented through number of global and regional initiatives.

137. IOC priorities and actions on Harmful Algal Blooms are set by the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) and the programme is implemented via number of global and regional initiatives. The research component, GlobalHAB, which is jointly sponsored with SCOR, has finalized and launched its Science and Implementation Plan and a new website. GlobalHAB has also formed an editorial board to develop a ‘Best Practice Guidelines for the Study of HABs and Climate Change’ to focus research on the occurrence of HABs under changing climate conditions. To help the desalination industry tackle an issue that represents a potential threat both to human health and to the distribution of desalinated water on which an increasing number of arid countries rely for their fresh water needs, IOC launched Manual and Guide, 78 entitled Harmful Algal Blooms (HABs) and Desalination: A Guide to Impacts, Monitoring, and Management on 16 October 2017 at the International Desalination Association World Congress in São Paulo Brazil. It is the first ever guidebook on the growing problem harmful algal blooms pose to seawater desalination plants. The endeavours to develop the first Global HAB Status Report based on data compiled in IOC/HAEDAT (maintained in cooperation with IODE), OBIS and the literature continues with the collaboration of IAEA, ICES, and PICES and with the financial support of Flanders (Kingdom of Belgium). The IOC-IAEA-FAO-WHO Inter-agency Joint Strategy on Ciguatera Fish Poisoning was further developed and implemented through joint workshops and alignment of agency workplans during 2018.

138. The research component under IPHAB, GlobalHAB, which is jointly sponsored with SCOR, has based on its Science and Implementation Plan a number of initiatives under development. One initiative is on HAB event modelling with a strong training component including development of an online textbook on HAB modelling. A special issue of the journal Harmful Algae (Impact Factor 4.138) is in preparation on HABs and climate Change and an IOC-SCOR Scientific Summary for Policy Makers on HABs and Climate Change is being developed based on the main messages in the papers of the special issue. The draft is to be presented at 14th Intergovernmental session of IPHAB in Paris, on 24–26 April 2019. GlobalHAB has formed an editorial board to develop a ‘Best Practice Guidelines for the Study of HABs and Climate Change’ to focus research on the occurrence of HABs under changing climate conditions. Draft chapters are due by May 2019. An international GlobalHAB workshop on evaluating, reducing and mitigating the cost of harmful algal blooms is being organized in Victoria, British Columbia, Canada on 17–19 October 2019 as part of the Annual Meeting of the North Pacific Marine Science Organization (PICES) and is receiving additional co-sponsorship from
NOWPAP, ISSHA and US NOAA. It has for several years been on the priority list of both IPHAB and GlobalHAB to focus specifically on Fish Killing HABs. An international workshop is planned for Puerto Varas in the South of Chile for June 2019 and is co-funded by the Chilean Centre for Studies of Harmful Algae (CREAN). HAB related fish kills are a very important issue for salmon culture. There is rapid technological development in different types of observation systems and GlobalHAB is jointly with SMHI/Sweden organizing an international workshop to test, inter-compare and train participants in various automated and non-automated observation technologies. Collaboration between GlobalHAB and GO2NE has been initiated and a joint expert meeting on HABs and Deoxygenation is planned for 11–12 June 2019 in Paris. GlobalHAB is even covering brackish and freshwater HABs through the development of a mitigation manual as well as a global mapping of HAB events caused by cyanobacteria/bluegreen algae.

139. The comprehensive undertaking to develop the first Global HAB Status Report based on data compiled in IOC/HAEDAT, OBIS and the literature continues with the collaboration of IAEA, ICES, and PICES and with the financial support of Flanders (Kingdom of Belgium). The IOC-IAEA-FAO-WHO Inter-agency Joint Strategy on Ciguatera Fish Poisoning is being further developed and implemented though joint workshops and alignment of agency workplans and a draft Memorandum of Understanding is being processed for signature early 2019.

140. Through the IOC Science and Communication Centre on Harmful Algae the longstanding opportunities for capacity enhancement in monitoring of HABs continues with several annual courses with examination giving the trainees certification in identification of HAB causative species. The IOC Centre in collaboration with the Marine Institute (Ireland) also operate the International Phytoplankton Inter-calibration (IPI) which in 2018 involved 99 analysts from 47 laboratories. Accreditation of the IPI under ISO17043 is expected for 2019.

141. HAB-ANCA organized the “Workshop for the Development of National Protocol Models for Risk Management of Harmful Algal Blooms in Marine Coastal Waters in the IOCARIBE Region” on 12–14 November 2018 in Panama. Its goal is to reduce the vulnerability existing in the Caribbean in case of threat of toxic and harmful events produced by microalgae generating risk management protocol models that can be adapted to the specific conditions in the IOCARIBE region. There were 40 participants from eight countries.

142. In response a pilot project and a workplan for sargassum and oil spills for the Caribbean and adjacent regions have been outlined by IOCARIBE, IOCARIBE-GOOS and IODE in association with GEO Blue Planet, and with partners including that include UN Environment, OECS, CRFM (Caricom), NOAA (USA), NASA (USA), UNAM (Mexico), CICESE (Mexico), CLS Group (France), RPS Group (UK), Texas A&M University (USA), University of South Florida (USA), Federal University of Pará (Brazil) INVEMAR (Colombia), and the Ministry of Sciences, Technology and Innovation (Brazil).

Key Challenges Encountered in Implementation and Remedial Action Taken

143. Current and future work of the ICG/IOTWMS is focused towards system sustainment and enhancements, strengthening early warning in the Makran region as well as enhancing community awareness and response. There are several gaps in observing networks that need wider data sharing among Member States. The recent Palu and Sunda Strait tsunamis in Indonesia have once again highlighted the urgent need to enhance community preparedness for near-field tsunamis, and at the same time strengthen warning systems to be able to warn for tsunamis caused by landslides and volcanic activities. The Indian Ocean Tsunami Ready (IOTR) programme that provides a structured framework for enhancing the state of community readiness has attracted interest of several Member States in the Indian Ocean and needs to be encouraged. Core funding for the IOTWMS Secretariat provided by the Government of Australia through the Bureau of Meteorology (BoM) continues to be vital for the stability of the Secretariat and the ICG. Activities supported by BMKG, Indonesia as part of their ongoing support for IOTIC are leveraged in planning inter-sessional activities, as integrated meetings, to maximise Member State participation.
144. Within NEAMTWS just over half of the Member States presently subscribe to the alert services from the Tsunami Service Providers (TSPs). IOC continues to raise awareness of these services. Over the last three years several tsunamis have been recorded in the NEAMTWS region e.g. Lithakia (26 October 2018), Aegean Sea (21 July 2017), in Alboran Sea (25 January 2016) and in the Ionian Sea (17 November 2015). Although moderate in size, these events highlight the tsunami threat/risk in the NEAM region, the need for optimizing the warning system and significantly enhance tsunami education and awareness in the region.

145. There continues to be gaps in the seismic and sea-level network notably in North Africa. Some countries have difficulties sharing observations due to national policy. The implication is sub-optimal performance of the regional Tsunami Warning Systems. IOC continue to appeal to Member States to participate and contribute fully in NEAMTWS.

146. The NEAM Tsunami Information Centre (NEAMTIC) remains unfunded and under resourced. Member States are invited through funding and secondments to contribute to the implementation of the NEAMTIC Strategy.

147. The on-going development of the global tsunami early warning system (TEWS) requires continuous development of all of its elements to effectively prepare for and respond to the threats posed by tsunamis and other coastal hazards. The activities of IOC in this field focus on building the institutional capacity of the national mandated bodies, reinforce community preparedness and organize and disseminate standards for tsunami-related services, and preparedness, readiness and resilience. With small core resources and significant extrabudgetary contributions, this task is becoming increasingly difficult. Staffing reinforcement is required to cope with it.

148. An improved coordination between IOC-HAB and HAB-ANCA regional initiatives allowed a better implementation of IOC Ciguatera Strategy and HAB programme in the IOCARIBE region. The work with health authorities have enhanced the implementation of practical solutions to address the vulnerability to the threat of toxic and harmful events in the IOCARIBE region.

**FUNCTION D: ASSESSMENT & INFORMATION FOR POLICY**

*Support assessment and information to improve the science-policy interface*

**UN World Ocean Assessment (WOA)**

149. IOC continues to provide scientific and technical support to the World Ocean Assessment process established under the UNGA. A second cycle of assessment (2017–2020) was initiated under the UN Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, starting with the holding of five regional workshops in 2017 to build capacity, support the development of assessment(s) and facilitate outreach and awareness-raising. Two of these workshops were organized by IOC, the regional workshop covering the North Pacific, was hosted by WESTPAC together with the Government of Thailand (29–30 November 2017), whilst IOCARIBE and the Government of Brazil hosted the workshop for the Wider Caribbean and South Atlantic. These considered how assessments produced by the Regular Process can be structured to help policy-makers most effectively with their tasks; and how to improve arrangements for networking among various group of experts and organizations involved in the Regular Process. Both workshops further emphasized the importance of capacity building to achieve the integrated assessment of marine environment. This is possibly an element to pursue as part of the IOC CD Strategy. A second round of regional workshops took place in 2018 so as to, *inter alia*, inform the collection of regional-level information and data for the preparation of the second World Ocean Assessment. IOC nominated experts to several of these. In 2019, a Multi-stakeholder dialogue and capacity-building partnership event was held on 24–25 January at United Nations Headquarters in New York. The event aimed to increase awareness of the importance of the Regular Process and more generally the science-policy interface at all levels. It also sought to highlight the
importance of capacity-building in support of the Regular Process, including regarding the preparation of integrated assessments which are important to inform decision-making by policymakers and other relevant stakeholders. In-depth multi-stakeholder dialogues on current opportunities, gaps and needs in capacity took place. IOC through its Vice-chairperson Ariel Troisi delivered a keynote on the contribution of ocean science in global policy processes. The contribution of IOC in supporting capacity development through its dedicated CD strategy as well as its work on ocean literacy were recognized by several Member States.

Sustainable Development Goals (SDG)

150. In the context of the 2030 Agenda for Sustainable Development, several targets of SDG 14 are directly relevant to the work of IOC, particularly in the areas of marine pollution, ocean acidification, ecosystem-based management, as well as marine research capacity and transfer of marine technology. The Commission is supporting the development of a global SDG indicator framework for specific targets, primarily Targets 14.3 (ocean acidification) and 14.a (scientific knowledge and ocean research capacity) where IOC is identified as the UN custodian agency by the Inter-agency and Expert Group on SDG Indicators (IAEG-SDGs). Several activities were undertaken to advance the methodology of 14.3 and 14.a, as well as in relation to target 14.1 on marine pollution (Nutrients). These are reported under Function A.

GEBCO

151. The Nippon Foundation-GEBCO Seabed 2030 project, aimed at facilitating the complete mapping of the ocean floor by the year 2030 was officially launched on 20th February 2018 in Tokyo. The Nippon Foundation is planning to contribute US$ 18.5 million for the first ten years of the project. The aspiration is for Seabed 2030 to compile all available and newly collected bathymetric data into a high quality, high resolution digital model of the ocean floor and to promote international efforts to collect new data. Four Regional Data Assembly and Coordination Centres (RDACCs) and a Global Data Assembly and Coordination Centre (GDACC) based at the British Oceanographic Data Centre have been established to facilitate the collection of bathymetric data. Seabed 2030 operates under the guidance of the GEBCO Guiding Committee. In addition, IHO, IOC and the Nippon Foundation have established a sponsors committee to review the progress of the project on a regular basis (meets twice a year). In the future, it will be important to identify how Seabed 2030 can support the needs of IOC programmes through the regular work of the IOC User Requirements for GEBCO Working Group.

152. At the regional level, national hydrographic services in the IOCARIBE region are working in the development and publishing of the International Bathymetric Chart of the Caribbean and the Gulf of Mexico (IBCCA). These have established partnerships within the IHO MesoAmerican and Caribbean Sea Hydrographic Commission – MACHC and are working to coordinate analysis of regional data gaps and catalyze contributions for the completion of the Chart, as well as planning new bathymetric surveys to be developed as part of new GEBCO-Nippon Foundation SEABED 2030 Project.

Ocean and coastal Atlases

153. Work on the Caribbean Marine Atlas has progressed well in accordance with the workplan: the CMA is an online digital platform that supports the integrated coastal zone management (ICZM) and ecosystem-based management for Large Marine Ecosystems in the Wider Caribbean region—mainly Caribbean and North Brazil Shelf Large Marine Ecosystems (the CLME+ Region). The Atlas is supporting the implementation of the CLME+ Strategic Action Programme.

154. In this context, CMA2 developed a new and updated workplan jointly with CLME+ in order to advance the prototype of the content for CLME+ SOMEE (State of the Marine Environment and associated Economies) information from the Atlas. Progress was made by publishing seven indicators. In addition, an “ecosystems’ methodological sheet” was developed to advance on two
more indicators. This is a country voluntary contribution to SDGs. The Atlas was launched on the Oceans World Day (8th June 2018) including the demonstration of the Atlas platform in three countries. Special attention is paid to coastal hazards, climate change and biodiversity, as well as habitats, fisheries and pollution - the three main transboundary problems identified in the CLME+ Region. CMA brings together 25 countries, 7 of which are actively providing ICZM national information and data for regional indicators. CMA currently holds more than 800 GIS layers. The Atlas is addressed to professionals in charge of planning and development, ministries and national and regional authorities, decision- and policy-makers. The CMA2 project, funded under the UNESCO/Flanders Fund-in-Trust has now started its final year.

155. In terms of dissemination, CMA2 have been promoting the use of its platform at several scientific and technical events including CoastGIS 2018 - International Coastal Atlas Network ICAN Mini-workshop, 28 September 2018, Isafjödur, Iceland; the Regional Experts Workshop on Harmonised Marine Litter Monitoring Programmes, 18–19 October 2018, Miami, Florida; the Gulf Caribbean Fisheries Institute 71st Conference, 5–9 November 2018; the RAMSAR Convention, 13th meeting of the Convention of the Parties COP13 Duba, 21–29 October 2018; and the 9th Conference of the Meso-American & Caribbean Sea Hydrographic Commission MACHC, 30 November 2018, at the Regional Training Center for Latin America and Caribbean–OTGA. CMA2 is being introduced during training courses as a tool for spatial information for Integrated coastal zone management.

156. The development of the African Coastal and Marine Atlas (ACMA) continued, with a workshop organized on 12–16 March 2018 in Swakopmund, Namibia in collaboration with the Benguela Current Commission and the Namibia National Marine Information and Research Centre, during which training was provided on Geonode and the atlas layers migrated from SmartAtlas to GeoNode.

157. The long-term strategic goal of the International Coastal Atlas Network (ICAN), under IODE, is to encourage and help facilitate the development of digital atlases of the global coast based on the principle of distributed, high-quality data and information. These atlases can be local, regional, national and international in scale. The ICAN is an IODE project since 2013.

Workshops and Outreach activities

158. In September 2018, ICAN organized a mini-workshop in conjunction with the International CoastGIS Conference in Iceland. The workshop focused on recent ICAN member activities around the world, and on the topic "How ICAN and coastal web Atlas operators can contribute to SDG 14 and the UN Decade of Ocean Science objectives?" The workshop was well attended and some valuable feedback was received from the group regarding the upcoming ICAN workplan.

Technical support to Regional Atlases

159. ICAN members from Columbia and the ICAN Technical team participated in workshops related to the African Coastal Marine Atlas (ACMA) in late 2017 and early 2018. These efforts resulted in a proof of concept delivery of an instance of the GeoNode platform customized to serving the previously produced products of the ACMA community. The GeoNode Platform is also in use in the Carribbean Marine Atlas 2 (CMA2) project, and has been a great asset in that setting. It is hoped that a similar benefit will be had in the ACMA community.
Governance Meetings (Steering Group Meetings)

160. Meetings of the ICAN Steering Group (ICAN SG) were held via phone conference / web-x in December 2017, June 2018 and November 2018, with smaller working groups meeting more regularly during the summer of 2018 to plan the Iceland workshop.

Preparing for the UN Decade of Ocean Science

161. In early September ICAN SG responded to the call for expressions of interest to support preparatory activities for the UN Decade of Ocean Science for Sustainable Development. The ICAN response focused on core ICAN area strengths that could be contributed, such as capacity building around digital atlases and data and information portals, as well as general ocean literacy expertise and engagement channels such as the ICAN email network, bi-annual newsletter and social media outreach via Twitter. ICAN representatives also actively participated in project meetings, conferences and other activities related to knowledge exchange and capacity building on various continents and plan to continue to advocate for the Decade through such participation.

OBIS products supporting ocean assessments

162. Through the DIPS-4-Ocean Assessments project (a Flanders’ UNESCO Science Trust-Fund project) OBIS supports the development of indicators and data products. During the intersessional period, OBIS has provided biodiversity statistics and maps for the IPBES global and several regional assessments (http://ioibis.org/data/maps/). Based on data from sources such as OBIS, nine areas in the Baltic Sea have been described as Ecologically or Biologically Significant Marine Areas (EBSAs) according to the criteria of the Convention on Biological Diversity (CBD workshop, 20–24 February 2018, Helsinki, Finland). An SDG 14 exploration portal, released at the GEO-XIV Plenary in October 2018 in Washington DC, uses data from OBIS, and is developed by the Marine Biodiversity Observation Network (MBON) of GEO BON.

Regional activities

163. With a view to assess and inform decisions on plastic pollution, WESTPAC initiated micro-plastic research and monitoring in the region, with the first ever regional training workshop held on 20–22 September 2017, Phuket, Thailand with a view to networking expertise and generating knowledge on the distribution, fates and impacts of micro-plastics. A related side event was also organized during the “ASEAN Conference on Reducing Marine Debris in ASEAN Region,” Phuket, Thailand, 22–23 November 2017.

Key Challenges Encountered in Implementation and Remedial Action Taken

164. The IOC work in the area of assessments and information for policy is fully aligned with the international commitments related to global assessment such as the UN World Ocean Assessment, the SDG reporting framework, IPBES, IPCC and some regional assessments. Whilst IOC contributes to these assessment processes, IOC efforts are not always clearly visible in the end product. There is therefore a need to explain the essential role of IOC in the upstream efforts (in terms of science, observation and data requirement) that are essential in the compilation of assessment end-products. IOC’s comparative advantage lies in its unique position as an intergovernmental framework to advance research, identify new scientific issues through collaborative action. The intergovernmental nature of IOC and its position within the UN system as a competent organization under UNCLOS provides a conduit for delivering relevant information to support decision-making of Member States. Whilst core capacity related to the conduct of integrated marine assessment exists within the Secretariat, as well as expertise in indicator-based methodologies for assessing environmental, socio-economic, governance processes in the marine environment, the Commission has weak
capacity for transforming and analyzing data into policy relevant products. These gaps should be addressed in order to enable the Commission to contribute to global assessment processes and/or develop its own assessment products. The recruitment of a P4 position within the Marine Policy and Regional Coordination Section in 2019 is expected to strengthen the Secretariat and address some of these concerns.

**FUNCTION E: SUSTAINABLE MANAGEMENT & GOVERNANCE**

*Enhance ocean governance through a shared knowledge base and improved regional cooperation*

**Sustainable Development Goals – Follow up to UN Ocean Conference**

165. Following the 2017 UN Ocean Conference on SDG 14, more than 1,400 registered commitments from governments, UN entities, NGOs, private sector and other stakeholders, were pledged. In order to follow up on these commitments, foster new commitments and facilitate collaboration, the UN Special Envoy on the ocean, Amb. Peter Thomson, supported by UN DESA, have established the SDG 14 Community of Ocean Action, organized around 9 thematic clusters addressing the SDG 14 targets. IOC together with the Global Environment Facility have been requested to lead on COA# 9 on Scientific knowledge, research capacity development. IOC and GEF are working on the development of indicators to measure and report consistently SDG commitments related to science, capacity development and TMT. IOC regional subsidiary bodies also play a role in coordinating SDG commitments within their regions. For example, WESTPAC followed up on its two voluntary commitments focusing on ocean acidification monitoring (#OceanAction15274) and another on capacity development (#OceanAction15266). A workshop on the development of the regional network for monitoring the impacts of ocean acidification on coral reef ecosystems was held in Phuket, Thailand (12–15 December 2017), whilst the development of Regional Training and Research Centres (RTRCs) and their committed regular trainings and workshops continued. In Spring 2019, the UN General Assembly agreed to host the 2nd UN Conference on SDG 14 which will take place in Lisbon, Portugal in June 2020. The Conference hosted by the Government of Portugal and Kenya will have as a central theme: Scaling up Ocean Action based on science and innovation for the period 2020 to 2030: stocktaking, partnerships and solutions.

**Biodiversity in Areas beyond National Jurisdiction (BBNJ)**

166. The UN General Assembly decided in December 2017 through Resolution72/249 to organize an intergovernmental conference, scheduled over four meetings to be held over a three-year period (2018–2020) with the aim to finalise a new legally-binding instrument to conserve and sustainably use marine biodiversity in areas beyond national jurisdiction (the High Seas and the Area) under the UN Convention on the Law of the Sea (UNCLOS). Negotiations would address topics identified in the package agreed in 2011, namely environmental impact assessments and area-based management tools, including the establishment of marine protected areas in areas beyond national jurisdiction. It will also provide a governance mechanism that regulates access to and benefit sharing derived from marine genetic resources. Capacity development and transfer of marine technology are also being considered to serve all its future Parties including developing countries.

167. The Conference touches on areas of IOC’s competency, particularly the use of the best available scientific information as the basis for management decisions and conservation policies, the application of IOC Criteria and Guidelines for the Transfer of Marine Technology as a guiding principle as well as the potential contribution of the Ocean Biogeographic Information System (OBIS) as an effective global platform for the sharing of research data and information. IOC took active part in the first and second meeting of the Intergovernmental Conference, held in September 2018 and April 2019. In total, five side events have been co-organised by IOC to showcase the contribution of science to the BBNJ process.
Global Conference on Sustainable Blue Economy, 26–28 November 2018, Nairobi, Kenya

168. IOC participated actively in the Global Conference on the Sustainable Blue Economy hosted jointly by Kenya, Canada and Japan, and organized three side events with partners on the following topics: (i) Marine Spatial Planning and ecosystem-based approaches to support national and transboundary Sustainable Blue Economy; (ii) Towards a knowledge-based sustainable ocean economy: The contribution of ocean science, observation, and marine technologies towards sustainable blue economy; and (iii) Large marine ecosystems approach: an essential management and partnership tool for realizing blue economy opportunities. IOC also organized an exhibition showcasing its activities and made key contributions during the Signature thematic sessions, the Science and research symposium and the Leaders circle and closing ceremony.

Climate Change Mitigation & Adaptation

169. Since COP21, new elements of knowledge have emerged, thus enhancing scientific understanding of the interactions between ocean, climate and biodiversity. The well-being of marine ecosystems is recognized as central to address climate change, hence sustaining ocean science and observation is key to understanding these interactions, monitor ocean changes and inform adaptation strategies. In view of the launching of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030), the Ocean and Climate Platform and IOC organized the High Level Scientific Conference on 10–11 September 2018, at UNESCO Headquarters in Paris. The conference aimed at synthesizing recent scientific progress on ocean and climate interplays; evaluating the latest ocean-climate trends within the context of increased ocean action; and reflecting on ways to move “from science to action”. The event brought together 500 experts from the research community, civil society, businesses, decision-makers and UN entities, to share their expertise on ocean and climate related issues. The key messages of the Conference were subsequently presented at the Global Climate Action Summit 2018 (13–14 September, San Francisco, USA) and Ocean Day at UNFCCC COP 24 (Katowice, Poland).

Joint Roadmap on Marine/Maritime Spatial Planning (MSP)

170. IOC and the European Commission continue the implementation of the Joint Roadmap to accelerate marine spatial planning processes worldwide (#SDG OceanAction15346) as a follow-up of the IOC-EC Global conference on MSP in March 2017. The European Commission invited IOC to apply for an ad-hoc grant to develop internationally accepted guidelines for marine spatial planning, including transboundary projects in the Western Mediterranean and the Southeast Pacific and communication activities to support the Joint Roadmap. The MSPglobal project (www.mspglobal2030.org) proposal was accepted and officially launched with an Opening Conference organized in Paris (France) on 11–12 February 2019 with the participation of 120 experts from 50 different countries. IOC actively participated at the Our Ocean Conferences that took place in Valetta (Malta) in October 2017 and in Bali (Indonesia) in October 2018 with three key commitments related to the UN Ocean Decade, Marine Spatial Planning and Blue Economy and Ocean Literacy. Since June 2017, IOC/MPR has increased to 20 the number of capacity development activities dedicated to MSP, integrated coastal area management, sustainable blue economy and large marine ecosystems. These courses were organized in collaboration with Member States, the IOC regional subsidiary bodies and other regional organizations in 20 different countries with more than 3,000 direct and indirect beneficiaries. All training materials are available in four languages (English, French, Spanish and Portuguese) at the IOC MSP Website and in Cap-NET of UNDP. The IOC MSP website (http://msp.ioc-unesco.org) is now available in English, French and Spanish with the support of the Government Offices of Sweden. IOC and the European Commission jointly organized three International Forums on Marine Spatial Planning in May 2018 in Brussel (Belgium), in March 2019 in Saint Denis de la Réunion (France) and in May 2019 in Vigo (Spain) bringing together MSP practitioners from all ocean basins. A new collaboration framework to support IOC’s role in marine spatial planning and sustainable blue economy was agreed with the Government of Sweden with the organization of two high-level events at the 9th International Water
Conference in Marrakesh (MA) and the International Conference on Sustainable Blue Economy in Nairobi (KE) in November 2018.

**Large Marine Ecosystem (LME) programme**

171. In the second half of 2017, the GEF LME:LEARN project continued its implementation and the regional networks bringing GEF projects and the science community, were made operational with two regional meetings held in Zanzibar (Africa Regional Network) organized with IOCAFRICA and Montevideo (Latin America and the Caribbean) organized by IOCARIBE, both held in October and November 2017. The primary objectives of these meeting were to provide a forum for GEF funded projects, agencies, academia and institutes to network with one another; to enhance their understanding of activities in the region; and to identify partnership building opportunities. The 1st Asia-Pacific network meeting, was organized by WESTPAC on 3–4 May 2018. Several new ecosystem-based management toolkits were finalized in the 1st half of 2018 and will be disseminated through training. The 19th Annual LME Consultative Meeting was held in Cape Town, back to back with the Conference “Building International Partnership to Enhance Science-based Ecosystem Approaches in Support of Regional Ocean Governance”. More than 150 participants from UNEP, FAO, UNDP, IOC and other organizations and partners attended to discuss the modalities for better regional governance of the oceans. The participants proposed to establish a platform to facilitate regional ocean governance, starting with a focus on technical and scientific collaboration where IOC RSBs have a clear role to play in supporting regional governance. IOC will follow up through dialogue with relevant UN entities.

172. In 2018, the LME:LEARN project continued to be implemented in line with objectives and the previously approved workplan. Regarding networking, the project continued its efforts to strengthen the global governance of large marine ecosystems and their coasts. The second round of regional network meetings commenced alongside the launch of an introductory virtual training course on governance and MSP, followed by face-to-face training at the regional network meetings. Organized respectively with IOCAFRICA, and IOCARIBE, the regional network meetings took place in Dakar for the Africa region, with 30 participants from 14 countries, and the second one in Panama City for the LAC region, with 46 participants. Those were coupled with training sessions on Transboundary Marine Spatial Planning, Sustainable Blue Economy and Ocean Governance, and Economic Valuation. Both meetings also included private sector engagement sessions with 3-4 companies each in partnership with World Ocean Council, as well as science-to-management sessions. In February 2019, Viet Nam hosted the second regional network meeting for South East Asia, which was also coupled with a training course on MSP. The project conducted its first two Inter-Project Collaboration Opportunities, supporting CERMES and Caribbean States on Governance performance, CLME+ and PEMSEA on business community engagement. Finally, the LME20 took place in Marrakech with around 100 participants attending. In addition to being the global forum for GEF-funded and other marine and coastal practitioners, leaders and institutions, Regional Seas organizations and Fisheries Bodies, the meeting gave further impetus to the Cape Town process on regional Ocean governance. Finally, the participants attended the training sessions on MSP and marine toolkits. With regard to Knowledge Sharing, the project finalized the layout/design of six of the seven guidance toolkits (Environmental Economics, Governance, Marine Spatial Planning, Stakeholder Engagement, LME Strategic Approach, LME Scorecard). All toolkits are available in PDF and online formats and a dedicated part of the website was established. In terms of data and information management, progress was made in terms of a LME spatial metadata catalogue as well as a proposed data and information management plan for the LME portfolio. The project participated in two global dialogue events, namely the GEF Assembly, organizing a side event on regional ocean governance. A similar event was organized at the Sustainable Blue Economy Conference in Nairobi with over 200 people in attendance. Finally, the project supported four LME projects (South China Sea, Indonesian Seas, Bay of Bengal and Yellow Sea) to the East Asian Seas Congress where it supported two events in the course of the Congress to showcase project results and build partnerships. In terms of Communications and Outreach, partner IUCN executed numerous enhancements to the overall design and layout of the Large Marine Ecosystem Hub. They added global data layers for LME boundaries (including layers highlighting active LME’s
and those with featured content on the Hub), LME Ocean Health Index, National EEZ Boundaries, Protected Areas, Marine Protected Areas, FAO Fishing Areas, Marine World Heritage Sites, Continental Shelf, Coral Reefs, Mangroves, Seagrass, Seamounts, Ocean Pollution and Commercial Activity/Impact. Finally, in terms of project management the project concluded its mid-term evaluation process and the associated mid-term management response. A condensed project steering committee meeting took place at IWC9 in Marrakech to discuss this and the steering committee planned in May 2019 will focus on the sustainability of the project, given that one year is left before its termination.

173. The Caribbean and North Brazil Shelf Large Marine Ecosystems Project (CLME+) is supported by the following organizations: IOC of UNESCO, CARICOM Secretariat, UN Environment, CEP, OECS Commission, OSPESCA, CRFM, FAO-WECAFC, CCAD. A CLME+ SOME (State of the Marine Environment and associated Economies in the CLME+ region) Report Development Workshop was held in Cartagena, Colombia 1–2 February 2018. The over-arching objective was to kick-start the 2018–2019 CLME+ SOMEE reporting process, by achieving agreement on the way forward among key agencies and organizations that are expected/invited to contribute to its development, adoption and institutionalization.

Regional projects

174. The SPINCAM project (www.spincam3.net) has achieved a number of milestones and deliverables, these include a communication and dissemination plan (August 2017), the participation strategy including private socio-economic stakeholders (December 2017), the Glossary of terms, concepts and common definitions related to biodiversity, environment, waters and management of aquatic ecosystems (March 2018), the Data management plan (March 2018) and the identification and classification of coastal and marine ecosystems, pressures and services for the Southeast Pacific region becoming the first product of this characteristics developed using a single methodology in the five participating countries (March 2019). At national level, the national partners finalized the macro-survey on capacity development (September 2017), organized the launching event of SPINCAM 3 with national stakeholders (September 2017–March 2018) and analysed their national marine policies (January 2018). National partners have also created the interinstitutional groups and group of experts to support the pre-planning process for the development of strategic recommendations to develop national marine spatial plans. A new set of indicators dedicated to sustainable blue economy is under development and the existing regional indicators on the state of the coast and marine environment have been updated and integrated in the SPINCAM Regional Atlas in February 2019. SPINCAM together with BRESEP actively participated at the FUST Oceans event (14–17 May 2018) organized by IOC and the Government of Flanders in Brussels and the MSPforums in Brussels in May 2018 and in Vigo (Spain) in May 2019. National experts benefitted from four regional trainings dedicated to coastal and marine ecosystems, marine spatial planning and sustainable blue economy.

175. The SPINCAM Atlas updated in February 2019 the agreed 15 regional indicators with data compiled from national sources in 2018, new indicators dedicated to sustainable blue economy are currently under development using a common methodology for the five countries of the Southeast Pacific. The atlas contains more than 500 spatial datasets in May 2019 and national authorities continue the improvement and development of decision support tools in order to increase the synergies to implement both integrated coastal area management plans and the pre-planning phase of their national marine spatial plans.

176. IOC concluded the implementation of the project AQUACROSS (www.aquacross.eu) funded by the European Commission's Horizon 2020 Programme in November 2018. IOC-UNESCO delivered in April 2018 the final version of the AQUACROSS Data Management Plan (DMP) and in June 2018 the final version of the AQUACROSS Information Platform. Furthermore, IOC delivered an analysis of transboundary water ecosystems and green/blue infrastructures in the Intercontinental Biosphere Reserve of the Mediterranean of Andalusia (Spain) and Morocco and organized workshops for local socio-economic stakeholders of the two countries in Facinas / Tarifa – Cádiz
(Spain) and with national stakeholders in Tangier (Morocco) in February 2018. The results of IOC’s work in the context of AQUACROSS were presented at the 9th International Water Conference in Marrakesh in November 2018 with the support of the Government of Morocco and the Government of Andalusia (Spain). A multilingual storytelling tool available in Spanish, Arabic, French and English was launched during the conference in Marrakesh and it is fully operative at the Environmental Information Network of Andalusia (REDIAM) and the Regional Observatory of Environment and Sustainable Development Tanger-Tetouan-Al Hoceima (OREDD).

Work Programme of the IOC Regional Subsidiary Bodies

177. The IOC Sub-Commission for the Western Pacific (WESTPAC) continues to assist IOC Member States in the region to enhance their ocean governance by strengthening science-policy interface, and concerting the joint actions of research communities to address critical challenges for sustainable development. In addition to the fulfillment of its two voluntary commitments (ocean acidification monitoring and capacity development) to the UN Ocean Conference 2017, a number of regionally specific programmes were being conducted throughout the biennium, focusing on ocean processes and climate, marine biodiversity conservation, and ocean ecosystem health. The 12th Intergovernmental Session of the Sub-Commission (2–5 April 2019, Manila, the Philippines) further proved the essential role of WESTPAC in the region with the participation of around 100 delegates and representatives from 16 countries and key partners/programmes in the region, including the Coral Triangle Initiative and Regional Fishery Management Organization. WESTPAC, in close cooperation with IOC Paris, North Pacific Marine Science Organization (PICES), and other partners, is planning a UN Decade Regional Workshop for the North Pacific (31 July–2 August 2019, Tokyo, Japan) aiming to promote solution-oriented research, engage various stakeholders, align existing activities and develop new partnerships for the UN Decade of Ocean Science for the Sustainable Development (2021–2030). The 11th WESTPAC International Marine Science Conference was also scheduled for late August 2020, in Makassar, Indonesia, which will be attended by around 700-800 participants, offering another grand opportunity to achieve the objectives of the UN Decade.

178. The Fifteenth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) will take place in Oransjestad, Aruba, on 6–10 May 2019. Delegates from more than 20 countries, UN, international and regional organizations will gather to discuss the progress achieved in IOCARIBE focal programmes in 2017–2019, and the recommended plans for 2019–2021. Member States will discuss new ways of implementing IOC/IOCARIBE programmes by partnering with existing initiatives, the private sector and strengthening the work with universities, NGOs, and expert and institutional networks and associations. Particular focus will be on the contribution of IOCARIBE Member States to the UN Decade of Ocean Sciences for Sustainable Development, and to the SDG 14 implementation progress and challenges.

179. The IOC Sub-Commission for Africa and the Adjacent Island States (IOCAFRICA) implemented various activities to increase awareness of ocean issues in the region. These included a national information workshop on IOC programmes organized in Swakopmund, Namibia in March 2018 in collaboration with the Namibia National Commission for UNESCO, and activities to commemorate World Ocean Day in Kilifi, Kenya on 7–8 June 2018 in collaboration with the Pwani University. An essay competition was organized for university students and early career scientists, focusing on the UN Decade for Ocean Science for Sustainable Development (2021–2030), in particular on how Africa and the Adjacent Islands could contribute to, or benefit from the Decade.

180. The third session of the China-Africa Forum on Marine Science and Technology was co-organized by the State Administration of China (SOA) and IOCAFRICA on 28–30 November 2017 in Hangzhou, China. The purpose of the session was to review the progress made and recommended ways of strengthening collaboration. The forum was attended by more than eighty (80) marine scientists and managers, including 23 participants from 10 African countries (Egypt, Eritrea, Kenya, Madagascar, Mauritius, Mozambique, Nigeria, Senegal, Seychelles and Tanzania) and over 60 participants from 9 organizations in China. The forum focussed on Ocean Observations in the Indian Ocean, with 32 presentations made on a wide range of topics. The following areas for
bilateral and regional collaboration were identified: (i) Establishment of observation systems and deployment of buoys in the Western Indian Ocean region; (ii) Establishment of joint ocean science/research centres and strengthening those already established in collaboration with Chinese institutions; (iii) Review of existing memoranda of understanding between institutions in the region and Chinese institutions to facilitate greater collaboration and joint initiatives; (iv) Enhancing participation of Africa students in the China marine fellowship and exploring other avenues for collaboration in capacity development for marine science and technology; and (v) Organization and support for the Pan-African Conference on Marine Science and Technology.

181. **IOC Regional Committee for the Central Indian Ocean (IOCINDIO)** Officers and the IOC Secretariat continued their efforts and mobilized additional Member States and partners to implement the IOCINDIO-VI workplans and recommendations. This was done though issuance of calls for contribution, coordinated actions in the context of the Second International Indian Ocean Expedition (IIOE-2), such as the organization of an IOCINDIO side session at the International Indian Ocean Science Conference 2018 and 2019, respectively in Jakarta, Indonesia, 18–23 March 2018 and in South Africa at the Nelson Mandela University in Port Elizabeth, 11–15 March 2019. These workshops helped to gain the engagement of additional Member Member States for a reinforced revitalisation of IOCINDIO while also reinforcing cooperation with IIOE-2. They increased the level of ownership and appropriation of Member States, as demonstrated by offers from India and Kuwait to provide in-kind contribution to the IOCINDIO kick-off workshop on coastal vulnerability assessment for sea-level rise and storm surges at the new Category-2 International training centre on operational oceanography in India.

182. With the support of the IOC Secretariat, IOCINDIO developed new partnerships:

(i) the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) by attending the Regional Meeting of Marine Academic and Research Institutes in the Red Sea and Gulf of Aden (PERSGA Region) at its Headquarters in Jeddah, Saudi Arabia, 15–17th October 2018;

(ii) the United Nations Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-economic Aspects through a unique regional contribution to the second of the two regional workshops for the Indian Ocean (including the Arabian Sea and the Bay of Bengal), the Red Sea and Gulf of Aden and the ROPME/RECOFI area, under the auspices of the United Nations in Doha, State of Qatar, 26 November–1 December 2018.

**Key Challenges Encountered in Implementation and Remedial Action Taken**

183. In order to support sustainable management of ocean and coasts, IOC has developed a portfolio of projects that are delivering technical assistance and capacity development through regional interventions (e.g. MSP, LMEs, SPINCAM). These are generally depends on a single donor and have set lifespans. It is therefore important to diversify the source of extra-budgetary donors and develop sustainability strategies for each of these project. One step in this direction is for example the LME:Learn project which developed a resource mobilization strategy to sustain the core services that the IOC is providing to the LME community with an emphasis on moving from a funding approach to a financing one.

184. In addition to the new mandate provided by the UN Decade, IOC continues to engage in a growing number of global policy frameworks relevant to the ocean: BBNJ, SDG, WOA, UNFCCC, Blue Economy. This requires tailoring key messages for each type of constituencies to highlight the importance of ocean science and observation to the issues in question. Thanks to a stronger investment in communication in the last four years, IOC is now better equipped to engage specific non-technical communities and explain the impact of its work.

185. The lack of additional resources made available to the IOC Secretariat to lead and coordinate the preparation phase of the UN Decade remains a challenge. Only three countries (Republic of
Korea, Japan, and UK) have made financial contributions to support planning activities. Without additional resources, the Secretariat may not be in a position to deliver a Decade plan which fully reflects the need of all nations, simply because thorough consultations will not have been conducted in all regions. IOC has repeatedly called on Member States and various type of donor organization to contribute. A specific partnership event will be organized in the last quarter of 2019 to engage philanthropic organization in the Decade.

186. Regional subsidiary bodies (RSBs) serve as a key arm of IOC in regions, translating the broad spectrum of IOC global objectives into concrete actions at regional and national level. Each of these are staffed with one single IOC professional. This long-term understaffing situation is indeed difficult for RSBs to deliver on the unprecedented demands of IOC Member States.

FUNCTION F: CAPACITY DEVELOPMENT
Develop the institutional capacity in all of the functions above, as a cross-cutting function

IOC Capacity Development Strategy

187. The IOC Assembly adopted the IOC Capacity Development Strategy, 2014–2021 through Resolution XXVIII-2 and agreed that the IOC global and regional programmes needed to develop programmatic and regionally relevant capacity development workplans based on this strategy and related needs assessments conducted in a consistent manner, building on ongoing activities and making use of existing training and education facilities. This resulted in document (IOC-XXIX/2 Annex 17: IOC Capacity Development Strategy, 2015–2021 and its Implementation Plan: Status Report) submitted to the Assembly at its 29th session. That session established the "IOC Group of Experts on Capacity Development". IOC Circular Letter 2680 was issued on 11 July 2017 inviting IOC Member States as well as Scientific, Technical and Regional subsidiary bodies to nominate members of the IOC Group of Experts on Capacity Development (IOC GE-CD). The First Session of the Group was held at UNESCO Headquarters on 21–23 March 2018. The Group will continue its discussions with the objective of reporting to the 30th Session of the IOC Assembly, June/July 2019. At the first session of the Group of Experts it was decided to establish two task teams: one on CD requirements of Member States (with special attention to SIDS), and one on the implementation of a Transfer of Marine Technology/Clearing House Mechanism “portal”. The task teams decided to develop a joint online survey to collect the necessary information and IOC Circular Letter 2738 was issued on 5 October 2018. The circular letter also invited Member States to designate an IOC National Focal Point in Capacity Development to enable more effective communication with the IOC on CD and CHM issues and to assist with the future implementation of the IOC CD Strategy by Member States. A total of 49 responses was received (12 from IOCAFRICA, 12 from IOCARIBE, 12 from WESTPAC and 11 from other Member States not members of any IOC regional bodies). Only two responses were received from IOCINDIO Member States, so these were not considered representative of the region in the framework of the analysis. The survey results were reviewed and analyzed during a meeting of both Task Teams, held at UNESCO Headquarters on 13-14 March 2019.

188. Regarding CD needs the survey results demonstrated some differences between the regions. Regarding the development of a Clearing-House Mechanism for the Transfer or Marine Technology all regions reported that such a mechanism would be instrumental to the further development of ocean science capacity in countries. Regarding the functional format, all regions expressed preference for an online central portal integrating the data and information harvested from regional/sectoral CHM portals (need for interoperability). As such the respondents identified the need for a series of nodes rather than one global central node but using technology that allows interoperability between the nodes. A “regional TMT/CHM portal prototype for Latin America project” was started by INVEMAR (Colombia). A demonstration will be made during this Assembly session.
189. In the context of priority areas of research and development for the UN Decade of Ocean Science for Sustainable Development (2021–2030), all respondents across all regions identified “Capacity development and accelerated technology transfer, training and education, ocean literacy” as the top priority.

190. A presentation on the work of the Group as well as the outcome of the online survey was presented during the sessions of IOCAFRIA, IOCARIBE and WESTPAC.

191. The Task Teams prepared 11 suggestions/recommendations that were forwarded to the Group of Experts for review and further action. The Group of Experts worked on this by email and formulated a draft decision submitted to this Assembly session.

**IODE's OceanTeacher Global Academy**

192. The IODE established the OceanTeacher Global Academy Project to implement a global network of Regional Training Centres (RTCs) to deliver customized training for ocean experts and practitioners and to increase national and regional capacity in coastal and marine knowledge and management. OTGA currently has seven active RTCs (Belgium, Colombia, Senegal, Kenya, Mozambique, India and Malaysia) and two candidate RTCs (China and Iran). During the past intersessional period, OTGA organized 16 face-to-face training courses at the 7 RTCs, involving 376 participants. Courses focused on a range of topics related to IOC programmes, contributing to the sustainable management of oceans and coastal areas worldwide, and relevant to Member States in the regions. Four different languages (English, Spanish, French and Portuguese) were used during the different training courses and workshops depending on venue, and all training resources were hosted by the OceanTeacher e-Learning Platform (www.oceanteacher.org). Currently, over 4,200 users are registered on the Platform.

**Ocean literacy**

193. The voluntary commitment “Ocean Literacy for All” coordinated by the IOC was announced at the first UN Ocean Conference (New York, June 2017). The implementation of the voluntary commitment started in August 2017 thanks to the support of the Swedish Government. In December 2017, the IOC organized the first Ocean Literacy conference (Venice, Italy). This event was the first of its kind and aimed at gathering the most prominent international actors from a wide variety of backgrounds, including Ms Gesine Meissner, Member of the European Parliament, Mr Peter Thomson, UN Special Envoy for the Ocean, Ms Francesca von Habsburg, Thyssen-Bornemisza Art, Contemporary and the Executive Secretary, together with over one hundred participants, representing governmental and intergovernmental bodies, public administrations, private foundations, universities, media and NGOs from 30 countries covering all regions (Europe, Africa, North and South America and Asia). During the conference the Ocean Literacy for All – A toolkit was launched. The toolkit is meant to provide educators and learners with innovative tools, methods and resources to understand ocean processes and functions, to alert them on the most urgent ocean issues and to provide ready to use activities to be implemented in formal and non-formal educational contexts. Currently the toolkit is being tested in schools of 36 countries belonging to the UNESCO Network of Associated Schools (ASPNet). The IOC Ocean Literacy Portal was launched in July 2018 with the aim of being a repository for quality education and information tools, resources, good practices and local or international success stories. In 2018 a partnership was established with the Ocean Frontier Institute, the Dalhousie University and the National Film Board of Canada to develop a feasibility study for the internationalization of the Ocean School Programme. Ocean School is an ocean science educational programme, which uses storytelling techniques, immersive technologies and interactive media to promulgate ocean literacy. An Ocean School Teacher Training Workshop was organized in San José, Costa Rica (3–4 December 2018), in collaboration with the UNESCO Office, to test the possibility of adapting the Ocean School programme and technology to different educational systems and geographical and cultural contexts. In November 2018 the First Ocean Literacy for multi-stakeholder processes in Ocean Governance workshop was organized in Paris at UNESCO HQ. Ocean Literacy experts, journalists, researchers, foundations, MSP practitioners,
educators, representatives of NGOs and public authorities participated in the workshop with the aim of discussing the most effective ways to communicate ocean knowledge to different audiences, and to share best practices and innovative views on the challenges of transforming knowledge into action, using Ocean Literacy tools. The event represented a bridge between the “Ocean Literacy for All” and the “MSP Global”.

IOC Regional Subsidiary Bodies

IOCAFRICA

194. Capacity Development continues to be a key focus for IOCAFRICA, with regional training centres for the Ocean Teacher Global Academy established at the Kenya Marine and Fisheries Research Institute – (Mombasa, Kenya), Eduardo Mondane University (Maputo, Mozambique) and the Centre de Recherches Océanographiques de Dakar-Thiaroye CRODT/ISRA (Dakar, Sénégal) hosting training course on a wide range of topics during the inter-sessional period including: Research Data Management (3–7 July 2017, Mombasa, Kenya), Marine Biodiversity Data Management (17–20 July 2017 in Dakar, Senegal and 12–16 February 2018, in Mombasa, Kenya); Application of Remote Sensing and GIS to Marine and Coastal Management (22–26 January 2018, Maputo, Mozambique); Hydrodynamic and Environmental Modeling (28 May–1 June 2018, Dakar, Senegal).

195. IOCAFRICA has developed linkages with other organizations working in the region such as WIOMSA and the secretariats of the UN Environment regional conventions in order to benefit from synergies.

IOCARIBE

196. The IOC Capacity development has always been a major element of IOCARIBE’s programmes and activities. IOCARIBE has a series of delivery mechanisms used for achieving its Capacity Development, among them IOCARIBE Strategic Sciences Plan (2017–2026), a draft CD strategy; a number of programmes and projects such as IOCARIBE-GOOS, CARIBE-EWS, ODINCARSA, CLME, OTGA, HAB-ANC. Also the work with IOCARIBE partner organizations such as WMO, UNEP, UN-DOALOS, IAEA, FAO, the European Commission, Regional organizations and NGOs. In most of the cases those organizations have their own capacity development strategies and programmes, and Member States national initiatives, bilateral, multilateral projects some not linked directly to IOCARIBE.

197. The IOCARIBE Medium Term Strategic Science Plan (2017–2026) (IOCARIBE SSP) objectives are to: (i) Support strategic planning of IOCARIBE Member States in relation to the development of marine sciences, oceanic observations and associated services; (ii) Facilitate a coherent management of regional programmes related to the marine-coastal environment and its resources; and (iii) Strengthen scientific basis supporting regional programmes. IOCARIBE SSP Lines of Action are: (i) Oceans and Climate; (ii) Ocean Science, technology and sustainable use of Coastal and Ocean Resources with special emphasis on Large Marine Ecosystems and Integrated Coastal Area Management; (iii) and Extreme Natural Hazards.

198. The IOCARIBE region has been increasing its capabilities in the marine sciences in recent years. Governmental structures have also strengthened. The inventory of higher education institutions identified 141 academic higher education institutions in the Americas that offer 777 Ocean Sciences programmes including 239 B.Sc. 191 M.Sc. 185 Ph.D. programmes in LAC. In the United States are 30 institutions with 69 Ph.D., 65 M.Sc. and 63 B.Sc. As well, students and scientists have other opportunities in Canada that has 14 Ph.D., 19 M.Sc. and 18 B.Sc. However, 70% of that capacity is concentrated in only five Latin American countries (Brazil, Mexico, Chile, Argentina, Colombia) and USA. The major challenge in the ocean sciences is the asymmetrical development and capacity of Member States.
199. IOCARIBE, IODE, CARIBE-EWS and the Marine Policy and Regional Coordination Section have carried out a series of Workshops during the period May 2017–May 2019 in the region. Particularly at the OTGA Regional Training Center INVEMAR in Santa Marta, Colombia: (i) Marine Spatial Planning (MSP) and Integrated Coastal Area Management (ICAM) 11–14 July 2017; (ii) workshop on marine biogeographic data management for enhancing OBIS use, 12–16 June 2017; (iii) Ocean Literacy and Story Telling Maps Training Course, 13–15 September 2017; Digital Repositories: the pathway from Open Access to Digital Asset Management, 27–30 November 2017.

200. During the period 2014–2017, 43 training activities were carried out (including Workshops, seminars, post-graduate courses in HABs, Tsunami and other coastal hazards, ICAM & MSP; IODE, GIS, GODAR, OBIS, Disaster Risk reduction, Marine Scientific Research within UNDOALOS framework, mapping) and a total of 1,022 persons from 31 countries were trained (2014: 120; 2015: 294; 2016: 364; and 2017:244), including 225 at INVEMAR and 27 at NSU.

201. The Subcommission has been working in the implementation of CD recommendations and Plan main Outcome "Strengthening IOCARIBE Member States capacity for a sustainable use of ocean and coastal resources and an increased resilience to climate change." Twenty-five Member States adopted the IOCARIBE Medium Term Strategic Science Plan (2017–2026) as the basis for developing IOCARIBE CD workplan, whose objectives are to: (i) Support strategic planning of IOCARIBE Member States in relation to the development of marine sciences, oceanic observations and associated services; (ii) Facilitate a coherent management of regional programmes related to the marine-coastal environment and its resources; and (iii) Strengthen scientific basis supporting regional programmes.

202. The region has been increasing its capabilities in the marine sciences in recent years. Governmental structures have also strengthened. The inventory of higher education institutions identified 141 academic higher education institutions in the Americas that offer 777 Ocean Sciences programmes. However, 70% of that capacity is concentrated in only five Latin American countries and USA.

203. IOCARIBE, IODE, CARIBE-EWS and the Marine Policy and Regional Coordination Section have carried out a series of workshops during the period May 2017–June 2018 in the region. Particularly at the OTGA Regional Training Center INVEMAR in Santa Marta, Colombia:

(i) Workshop on marine biogeographic data management for enhancing OBIS use from 12 to 16 June 2017 (Female-13/ Male-10); (ii) Marine Spatial Planning (MSP) and Integrated Coastal Area Management (ICAM) 11–14 July 2017 (F-4/ M-11); (ii) Information Technologies – GIS applied to the marine and coastal environment, 18–22 June 2018 (F-9/ M-11); (iii) Integrated Coastal Zone Management and Marine Spatial Planning / MIZC-PEM, 13–17 August 2018 (F-12/ M-14); (iv) Marine Biogeographic Data Management – OBIS, 10–14 September 2018 (F-8/ M-5); (v) Blue Carbon and Ecosystem-Based Adaptation: The Role of Marine and Estuarine Wetlands in Addressing Climate Change (Emphasis on Mangroves and Seagrasses), 1–5 October 2018 (F-15/ M-8); (vi) Marine Protected Areas (MPAs), 19–23 November 2018 (F-9/ M- 5); (vii) Administración de Datos Biogeográficos Marinos, 12–18 January 2019; (viii) Second Set of Indicators Workshop for the Caribbean Marine Atlas (F-4/ M-4), 12–14 February 2019; (ix) Latin America and Caribbean Advanced Training on Ocean Acidification 28 January–1 February 2019.

WESTPAC

204. WESTPAC contributes to the implementation of the IOC Capacity Development Strategy (2015–2021), emphasizing “training through research” approach and applying integrated capacity building tools. Two voluntary commitments were made by WESTPAC in June 2017 to the UN Ocean Conference Call for Action, with one focusing on “Develop research capacity and transfer of marine technology through the UNESCO/IOC Regional Network of Training and Research Centers (RTRCs) on Marine Science in the Western Pacific and adjacent regions in support of the SDG 14.a”. The commitment is being fulfilled, through the planning and conduct of annual international trainings by the two already established RTRCs, and other RTRCs to be established. The Regional Training and
Research Center on Ocean Dynamics and Climate (RTRC-ODC) organized its annual international trainings on model development (12–23 June 2017, Qingdao, China) and regional ocean forecasting systems (2–7 July 2018, Qingdao, China) in conjunction with the CLIVAR-FIO Summer School on “Past, present and future sea level changes” (25–30 June 2018). The Regional Training and Research Center on Marine Biodiversity and Ecosystem Health (RTRC-MarBEST) conducted an international training on Molecular Taxonomy (25 September–6 October 2017, Jakarta, Indonesia) and another on Coral Health Index (22 October–2 November 2017, Jakarta, Indonesia).

205. To assist countries in the region addressing their development challenges, WESTPAC takes initiative in developing national and regional capacity for microplastics research and monitoring, with its initial and second regional training workshops (20–22 September 2017, Phuket, Thailand & 15–17 October 2018, Shanghai, China) held on the distribution, source, fate and impacts of marine microplastics) and second one. To safeguard ocean health and ensure seafood safety, WESTPAC endeavours to enhance national/regional capacity for “applying analytical method for detecting Ciguatoxins (CTXs) in fish” (5–9 April 2018, Nha Trang, Viet Nam), and “HAB mitigation and management” (31 October–4 November 2017, Tokyo, Japan), 4th and 5th WESTPAC training workshop on monitoring the ecological impacts of ocean acidification on coral reef ecosystems (14–15 December 2017, Phuket, Thailand & 5–7 November 2018, Xiamen, China), and a training Workshop on Introductory Scientific Diving for Marine Benthic Dinoflagellates Sampling and Processing (17–21 September 2018, Phuket, Thailand).

IOCINDIO

206. The IOCINDIO work plan was endorsed by Assembly Decision IOC-XXIX/3.4.4 at its 29th session. The IOC recognized and adopted the crosscutting nature of Capacity Development based on a regional self-driven and leadership approach. Thus, each IOCINDIO project proposal aiming at implementing the workplan incorporated the capacity development component (Ref. IOCINDIO-VI/3s Paris, 18 June 2017).

207. During the reporting period, IOCINDIO Officers and the IOC Secretariat vigorously pursued the mobilization and support of additional Member States and partners for implementing specific capacity development activities: (i) IOCINDIO networking research infrastructures, facilities and human resources with dedicated questionnaire for inventory of existing oceanographic infrastructures, facilities and manpower; (ii) IOCINDIO Scientific, technical and innovations workshop on coastal vulnerability assessment for sea level rise and storm surges at the newly established UNESCO Category-2 International training centre on operational oceanography at the Indian National Centre for Ocean Information Services (INCOIS) (27–31 May 2019).

UNESCO Category 2 Centres

208. The UNESCO Category 2 Regional and Research Centre in the Islamic Republic of Iran on Oceanography for West Asia has successfully implemented the First International Conference on Oceanography for West Asia and two workshops.

209. In November 2017, the UNESCO General Conference, at its 39th session, approved the establishment of the “International Training Centre on Operational Oceanography” in Hyderabad, India as UNESCO Category 2 Centre, and the corresponding agreement was signed with the Government of India in May 2018. A new campus building along with facilities for faculty, students was inaugurated. The Centre conducted 9 training courses involving 225 scientist and covered various topics like remote sensing of marine phytoplankton, Discovery and use of operational ocean data products and services, Data visualization, Fish catch time series using R, Marine Geosciences using QGIS.

210. The report of both category 2 centres is available in IOC/INF-1370.
Key Challenges Encountered in Implementation and Remedial Action Taken

211. Staffing allocated to central CD coordination is currently only 0.2 FTE. This is insufficient to reach the ambitions of IOC in terms of implementation of the CD strategy and reaching IOC’s full potential. Similarly the Secretariats of the regional subsidiary bodies are understaffed and under-resourced. The part-time Secretariat for IOCINDIO remains a critical challenge for the full realisation of the Committee’s potential. Secondments/loans of personnel from Member States are being actively sought to support the work of all RSBs.
## Main Line of Action 1: Promoting knowledge and capacity for protecting and sustainably managing the ocean and coasts

**IOC Expected result 1:** Science-informed policies for reduced vulnerability to ocean hazards, for the global conservation and sustainable use of oceans, seas and marine resources, and increased resilience and adaptation to climate change, developed and implemented by Member States, towards the realization of the 2030 Agenda

### Performance Indicators (PI) and Targets (T)

<table>
<thead>
<tr>
<th>PI: Function A: No. of supported Member States which have conducted up-to-date ocean research to address specific challenges of the ocean and human impacts on coastal areas</th>
<th>Assessment of Progress against Target as at 31/12/2018</th>
<th>Likelihood that target will be attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 2018-2019: (i) 52 of which 7 from Africa and 7 SIDS (ii) 91 of which 24 from Africa and 13 SIDS (iii) 80 of which 8 from Africa and 4 SIDS</td>
<td>(i) 26 MS of which 1 in Africa and no SIDS according to the revised composition of the WCRP scientific steering committees (membership of individual science projects still evolving) (ii) 89 MS of which 22 in Africa and 12 SIDS (iii) 71 MS, of which 5 in Africa and 0 SIDS</td>
<td>Medium</td>
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<tr>
<th>PI: Function B: No. of supported Member States which maintained, strengthened and integrated global ocean observing, data and information system to reduce vulnerability to ocean hazards and benefit from their outputs</th>
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</thead>
<tbody>
<tr>
<td>T 2018-2019: (i) 60 of which 5 from Africa and 8 SIDS (ii) 13 of which 5 from Africa and 1 SIDS (iii) 20 (iv) 90 of which 22 from Africa and 13 SIDS</td>
<td>(i) 60 of which 5 from Africa and 8 SIDS (ii) 13 of which 5 from Africa and 1 SIDS (iii) 20 (iv) 96 data and information centres (NODCs, ADUs) in 71 Member States of which 19 are based in Africa</td>
<td>High</td>
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<tr>
<th>PI: Function C: No. of supported Member States which have developed early warning systems and preparedness to mitigate the risks of tsunamis and other ocean-related hazards towards increased resilience</th>
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<tbody>
<tr>
<td>T 2018-2019: (i) 75 of which 15 SIDS and 6 from Africa (ii) 9 of which 5 SIDS (iii) 5 of which 1 SIDS (iv) 13 of which 2 from Africa and 2 SIDS (v) 45 of which 6 from Africa and 5 SIDS</td>
<td>(i) Caribbean: 32 MS have Tsunami Warning Focal Points (TWFP) (16 SIDS) and 8 MS have NTWCs (1 SIDS); Pacific 47 MS have TWFPs (12 SIDS) and 15 MS have NTWCs (0 SIDS); Indian Ocean: 24 MS have TWFPs and NTWCs in the Indian Ocean (5 SIDS, 9 Africa); NE Atlantic &amp; Mediterranean &amp; connected seas 30 MS have TWFPs (2 Africa) and 11 NTWCs (0 Africa). (ii) 3 MS in the Caribbean (3 SIDS) and 10 MS in Central America (iii) To date no progress towards this target. To be reported on in the next cycle (iv) 10 MS of which 2 from Africa (v) 52 MS, here of 4 Africa and 10 SIDS</td>
<td>High</td>
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<tr>
<th>PI: Function D: No. of supported Member States that have ocean science and policy interface mechanisms in support of healthy ocean ecosystems in accordance with Agenda 2030</th>
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<tbody>
<tr>
<td>T 2018-2019: (i) 12 (ii) 25 of which 5 SIDS and 5 from Africa (iii) 45 of which 6 from</td>
<td>(i) 25 MS participate in GEBCO (ii) 308 Experts from 61 MS have been nominated to the WOA Pool of Expert, with 19 from Africa and 4 from SIDS. IOC directly nominated 10 experts including 1 from Africa. (iii) In response to a survey of all IODE data centres, 21 from 20 MS responded that they</td>
<td>Medium</td>
</tr>
</tbody>
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2 Reporting against the 38 C/5 (2016-2017) Results Framework was presented to the IOC Executive Council in 2018 as document IOC/EC-LI/2 Annex 1.
Africa (iv) 35 of which 5 SIDS and 7 from Africa (v) 9 of which 5 from Africa and 1 SIDS

manage data sets relevant to ocean acidification (1 in Africa) (iv) 14 of which 0 in Africa and 1 SIDS (v)5 MS of West Africa are developing coastal adaptation plans

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<tr>
<th>PI: Function E: No. of supported Member States which implement science-based ecosystem management and measure progress on SDG 14 implementation</th>
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<tbody>
<tr>
<td>T 2018-2019: (i) 88 of which 13 from Africa and 10 SIDS (ii) 45 of which 6 from Africa and 5 SIDS (iii) 13 of which 4 SIDS</td>
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<tr>
<td>(i) full assessment will be possible at the end of 2019 (ii) At least 30 MS, including 7 from Africa and 2 from SIDS experts/representatives participating in MSP international forum and training activities and applying knowledge towards the development of MSP national plans (iii) 7 MS of which 3 SIDS participated in UN outreach activities, through Side events at Blue economy conference and GEF IW Conference.</td>
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<th>PI: Function F: No. of supported Member States which have developed institutional capacity and used it towards IOC’s high-level objectives</th>
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<tr>
<td>T 2018-2019: (i) 10 of which 1 form Africa and 1 SIDS (ii) 60 of which 8 Africa and 8 SIDS including gender disaggregated human resources information from 45 MS (iii) (a) CD implementation plans adopted and implementation started, with minimal seed funding, otherwise dependent on XB (b) 120 practitioners MS, of which 20 from Africa and 5 from SIDS (iv) 100 practitioners of which 30 from Africa and 0 SIDS, with a gender target of 40% women (5 RTCs established)</td>
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<tr>
<td>(i) 37 MS responding to the CD needs assessment, including 5 SIDS and 6 from Africa (ii) 31 MS have provided data for the production of GOSR-II, of which 5 in Africa and no SIDS (iii) (a): CD implementation plan to be adopted in 2019 (b) training to be organized after adoption of CD plans in 2019 (iv) 9 OTGA RTCs established. 18 courses organized in 2018 at the 9 OTGA RTCs and support given to another 7 courses taking place at other venues (not OTGA RTCs). Nb of participants involved over 600, of which 89 from Africa and 21 from SIDS, trained in priority topics identified through regional assessments. Women 50%.</td>
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### Challenges and risks in implementation and remedial actions

<table>
<thead>
<tr>
<th>Key challenges</th>
<th>Remedial actions</th>
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<tbody>
<tr>
<td>1. In several cases the implementation of the foreseen scientific activities has been hampered by limited data accessibility. Open access to such data is not given, for example, in relation to plankton or ocean oxygen data. In some cases, limited data quality control also prevents global assessments of the issues studied.</td>
<td>1. Increased scientific capacity is built through summer schools and workshops. And data quality assurance is ensured through IOC-coordinated IGMETS and IODE networks.</td>
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<tr>
<td>2. Much of the distributed office supporting the Global Ocean Observing System is outside of IOC/UNESCO Headquarters and supported by volatile in-kind or voluntary contributions since the withdrawal of the USA financial support. The staff has funding horizons supported by projects ending in 2019, and so fundraising to support the essential coordination functions of GOOS and JCOMMOPS beyond mid-2019 is important. With these limited resources, the balance of “inward” activity connecting to the core ocean observing community and helping them on coordination and best practices, vs. “outward” partnership-building, communication and advocacy activity is difficult to sustain.</td>
<td>2. GOOS staff have engaged in the G7 Future of Oceans and Seas as a way of increasing voluntary contributions. Every effort is put into expanding the resource base as the only way to address both broad objectives of inwards coordination and outwards engagement.</td>
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<tr>
<td>3. Lack of national coordination regarding coastal and marine matters hampers the establishment of national data and information management facilities at the national level.</td>
<td>3. An outreach campaign is developed to increase the awareness of member states of the importance of national ocean data and information management expertise</td>
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