Item 4.2 of the Revised Provisional Agenda

ENHANCED COHERENCE, IMPACT AND FUTURE ORIENTATIONS OF THE IOC OCEAN SCIENCE PORTFOLIO IN SUPPORT OF THE UN DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT AND THE 2030 AGENDA

Summary

This document has been prepared by the Ocean Science Section of the IOC Secretariat as a contribution to the strategic reflection related to IOC and the future of the ocean and the role of ocean science therein.

Purpose of the document: The document suggests a streamlined structure of the Ocean Science portfolio of the IOC aimed at better contextualizing existing activities to the 2030 Agenda and its SDGs, and to the UN Decade of Ocean Science. It also draws Member States’ attention to: (i) the opportunity that IOC take on a coordinating role in the area of ocean carbon research through the set-up of a working group in partnership with IOCCP, SOLAS, IMBeR and the Global Carbon Project; and (ii) the timeliness and value-added of an IOC working group on multiple ocean stressors, building of existing IOC activities.

The Ocean Science Section of the IOC Secretariat wishes to acknowledge the substantive contribution of IOCCP to section II of the document. The document has also benefited from the review of IMBeR, SOLAS and GCP.

The financial and administrative implications of the activities reflected in the document fall within the parameters of the regular budget of IOC for 2017–2019 and shall be reconsidered at the 30th session of the IOC Assembly.

The Proposed decision is referenced EC-LI/Dec.4.2 in paragraph 48 of this document.
I. Background

1. The IOC Ocean Sciences Programme was developed based on advice from the IOC Ad hoc Advisory Group for the IOC Ocean Sciences Section. The Group had produced its first report in 2007 (IOC/INF-1259). This report recommended that the IOC Ocean Sciences Programme focused on four pillars: climate impacts in the ocean; integrated coastal research; marine assessment; and marine modelling (crosscutting). The report informed the design of the work plan of the Ocean Science Section of IOC, which was presented at the 25th session of the IOC Assembly in May 2009. At that time, the various activities populating the IOC Ocean Sciences Programme were organized according to the High Level Objectives (HLOs) of the IOC Medium-Term Strategy 2008–2013. The programme also took into account the needs identified in relevant policy processes (Agenda 21, the Johannesburg Programme of Action, the Millennium Development Goals), as well as requests from the Chief Executives Board of the United Nations.

2. The IOC Assembly at its 26th session in June 2011 in its decision 8.1 requested the IOC Executive Secretary to reconvene the Ad hoc Advisory Group on the IOC Ocean Sciences Section to help in the preparation of the next Medium-term Strategy and the prioritization of the OSS activities. The Group finalized its second report in 2012 (IOC/INF-1294). The IOC Executive Council considered the report at its 45th session in 2012. In decision EC-XLV/Dec.4.4, the Council noted its conclusions and contribution to the IOC Medium-term Strategy for 2014–2021 and the proposed prioritization of the activities of the Ocean Sciences Section around four strategic themes or clusters. These four strategic themes or clusters were: science in support of sustainability of ocean ecosystems in a changing environment; assessing and predicting ocean health and variations in ocean goods and services; responding to governments; and science for the unknown sea.

3. At its 49th session in June 2016 the IOC Executive Council considered the terms of reference related to the continuation of the IOC International working Group for Marine Time Series (IGMETS) and two new initiatives presented by the IOC Secretariat: the IOC working group to investigate Climate Change and Global Trends of Phytoplankton in the Ocean (TrendsPO), in particular the coastal ocean; and the IOC working group for the Global Ocean Oxygen Network (GO2NE). Through Decision EC-XLIX/4.1(III), the Executive Council endorsed the continuation of IGMETS and the establishment of TrendsPO and GO2NE, with the recognition that the biological, physical and chemical characteristics of the ocean vary across a range of temporal and spatial scales, and at the same time are influenced by anthropogenic forcing (warming, acidification, pollution, etc.). In its decision, the Council recognized further the need for an intensified two-fold effort in distinguishing between natural and human-induced earth system variability, and analyzing the possible impacts and consequences on certain marine ecosystems and marine life in general, in line with the conclusions of the IOC Ad hoc Advisory Group for the IOC Ocean Sciences Section.

II. Current foci of the Ocean Science portfolio

4. Function A: Ocean Research of the IOC Medium-Term Strategy 2014–2021 (IOC/INF-1314) is discharged through the implementation of a number of substantive and coordinating activities by the Ocean Sciences Section of the IOC Secretariat (hereinafter referred to as the IOC Ocean Science portfolio). These activities entail a significant number of expert and working groups, some of which are under the sole responsibility of IOC, while others represent joint efforts of IOC with partner organizations. These are summarized in the table below.

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<th>Main activities constituting the IOC Ocean Science portfolio</th>
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<tr>
<td><strong>IOC sole or IOC-led expert and working groups</strong></td>
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<tr>
<td>GOA-ON: Ocean acidification and SDG indicator 14.3.1</td>
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<th>IOC sole or IOC-led expert and working groups</th>
<th>IOC co-sponsored expert activities</th>
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<tr>
<td>TrendsPO: Climate change and impacts on phytoplankton</td>
<td>Blue Carbon Initiative: The role of coastal marine ecosystems in mitigating CO₂ emissions (jointly with CI and IUCN)</td>
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<tr>
<td>GO2NE: Study of de-oxygenation in the world ocean</td>
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<td>IGMETS: Ecological time-series, modelling and predictions</td>
<td>SDG indicator 14.1.1: Nutrients and eutrophication (with UN Environment)</td>
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<td>HABs: IOC Harmful Algal Blooms Programme and Centre¹</td>
<td>GESAMP WG 41: Marine geoengineering (led by IMO)</td>
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<td>GOSR: Ocean science capacity and SDG indicator 14.A.1</td>
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5. All of the above-listed activities have a demonstrated record of contributing to the international research agenda; the design of observation programmes; the uptake of scientific research findings by the policy community; raising awareness and educating the public; and contributing to strategic choices related to investments in ocean science and how these, in turn, can contribute to sustainable ocean economies.

6. In the above-mentioned regard, examples of concrete achievements since the adoption of the 2030 Agenda in 2015 are:

- The endorsement of GOSR by the Inter-agency and Expert Group on Sustainable Development Goal Indicators as the mechanism to gather data on progress towards the achievement of SDG Target 14.A; and the upgrading of the methodology related to SDG indicator 14.A.1 (for which IOC acts as the custodian agency) from tier three to tier two, following the publication of the first edition of GOSR;

- The development of the methodology related to SDG indicator 14.3.1 (for which IOC acts as the custodian agency) by GOA-ON;

- The development of a draft methodology for SDG indicator 14.1.1 (eutrophication index) by an expert group co-convened by IOC and UN Environment;

- The production of a first time ever Global Assessment of the Sources, Fate and Effects of Microplastics in the Marine Environment by GESAMP WG 40, which includes sampling methodologies and impacts of nanoplastics and plastics as a vector for organisms. This expert work conducted thus far constitutes the basis for producing region-specific comparable assessments of plastics and microplastics in the marine environment;

- The development of approaches to mitigate climate change through coastal ecosystem management and of methodologies to systematically assess the role of seagrass, mangrove and saltmarsh systems in the context of Nationally Determined Contributions (NDCs) under the Paris Agreement, by the Blue Carbon Initiative (cf. also section III of the document);

- The continuous pivotal role of the WCRP, in particular, in the production of models critical to the development of scenarios for the Intergovernmental Panel on Climate Change (IPCC), through the WCRP Coupled Model Intercomparison Project (CMIP – cf. also document IOC/INF-1342 Part 2);

¹ also contributing to IOC Function C: Early warning and services
- A policy brief illustrating the status and trends in ocean de-oxygenation, its causes and possible policy responses, also taking into account a recent scientific article in *Science*, co-authored by members of the GO2NE expert group, including a member of the IOC Secretariat;

- Multiple science achievements on, and their contribution to better prevention and management of, HAB occurrences in the context of the IOC-SCOR GlobalHAB Programme and the work of the IOC Science and Communication Centre on Harmful Algae.

7. The above-described expert activities of IOC in the area of ocean science reflect: (i) the needs of IOC Member States for scientific and technical advice aimed at elucidating questions on the oceans to which they are exposed or in which they take an interest; (ii) the foresight role of the IOC Secretariat in alerting IOC Member States about emerging issues requiring expert attention; and (iii) internationally agreed goals and targets related to sustainable development and the role of the world ocean therein.

8. Several of the expert activities listed above pre-dated the adoption of the 2030 Agenda and its SDGs. However, because IOC had played a central role in informing the priority areas for knowledge generation and for actions under Sustainable Development Goal (SDG) 14, the scope and contents of the programme are also largely adequate from the point of view of the 2030 Agenda provisions and SDG 14 and related targets. The contents and architecture of the Ocean Science portfolio, therefore, remain generally valid several years after their endorsement in 2012, taking also into account the new activities added in 2016.

9. At the same time, the field of ocean science is highly dynamic and therefore evolves frequently. This is due to a combination of new findings emerging from scientific research with evolving priorities related to research funding, and the evolution in the focus of international research efforts. Policy requirements for scientific knowledge are also evolving. The IOC should proactively anticipate and respond to such changes if its Ocean Science portfolio is to remain relevant and so as to deliver scientific and technical advice to its Member States in a timely manner.

10. Specifically, recent developments related to ocean carbon research and developments related to the landscape of ocean carbon research activities seem to indicate the need to strengthen the IOC Ocean Science portfolio’s focus related to ocean carbon, responding to the demand for such coordinating role by the scientific community. This strengthened focus will also respond to growing demands on behalf of the policy-making constituency, particularly in relation to the United Nations Framework Convention on Climate Change (UNFCCC) (cf. section III of the document). Similarly, there is also a need to organize the expert work of IOC in relation to multiple individual stressors in the form of a coherent multi-stressor expert initiative, thus also contributing to the relevant preliminary objective of the United Nations Decade of Ocean Science for Sustainable Development (cf. section IV of the document). Finally, there may also be a need to reorganize the various existing activities into thematic clusters that would be better aligned with the Decade of Ocean Science and so as to ensure better alignment with other IOC Functions and the work of the other sections of the IOC Secretariat. Ultimately, the suggested measures will enhance the coherence and maximize the impact of the IOC Ocean Science portfolio.

III. A renewed focus on integrated ocean carbon research: Rationale, role of IOC and value added

a. Scientific considerations

11. The IOC Secretariat has followed, and engaged in, developments related to the new generation of ocean carbon research in consultation with relevant partners. Generating new knowledge on the role of ocean carbon in climate regulation and on the effects of climate change on ocean carbon, including carbon biology, will respond to growing needs for such knowledge from relevant initiatives and processes, namely the IPCC (also taking into account the findings and knowledge gaps in the IPCC Special Report on Ocean and the Cryosphere, in due course) and
scientific and technical work related to requests formulated by the UNFCCC and its Subsidiary Body on Scientific and Technical Advice (SBSTA).

12. The global ocean carbon research community is constituted by several initiatives carried out in the context of: the International Ocean Carbon Coordination Project (IOCCP); the Surface-Ocean Lower Atmosphere Study (SOLAS), the Integrated Marine Biosphere Research (IMBeR); the Global Carbon Project (GCP); WCRP's core project on Climate and Ocean Variability, Predictability and Change (CLIVAR), and numerous other relevant activities of IOC itself. Relevant national efforts on carbon research, as exemplified by the Ocean Carbon and Biogeochemistry programme under the US Carbon Cycle Science Program, contribute directly to such global efforts on ocean carbon research.

13. Historically IOC played a central role in federating the global ocean carbon research community through the SOCOVV workshop held in April 2007 at IOC's headquarters and follow-up meetings. IOC had supported the creation of IOCCP in the early 2000s, building on joint efforts of IOC during the previous two decades with SCOR and ICSU, including the CO2 Advisory Panel of the Committee on Climate and the Ocean and the subsequent Joint SCOR-JGOFS-CCCO Advisory Panel on Ocean CO2. IOCCP was hosted at, and its secretariat supported by, IOC until 2012. IOCCP is co-sponsored by IOC and SCOR.

14. While IOCCP tends to focus on ocean carbon observations, assisting in the development of new needed technology, and developing relevant capacity, there is a continuous need for an integrative platform on ocean carbon research, and a clear role for IOC therein.

15. An open discussion involving the main programmes active in ocean carbon research—IOCCP, GCP, WCRP/CLIVAR, SOLAS and IMBeR—led to preliminary scoping discussions on future ocean carbon research and the identification of the following questions:

- Is there a need for an international coordination in ocean carbon cycle research that goes beyond what is currently done? If so, how broad should such an activity be?
- What are the key questions that should guide this initiative?
- What kind of organizational setup is envisaged as appropriate?

16. The discontinuation in 2017 of the IMBeR and SOLAS carbon working groups that, based on the Joint SOLAS/IMBeR Carbon Implementation Plan, were charged with coordination and synthesis of ocean carbon research related to both ocean surface and ocean interior, creates the need for such a new federating initiative on ocean carbon research. This would contribute to inter alia better-coordinated ocean carbon cycle simulations in the context of CMIP6 and of the Global Carbon Project's efforts to establish annual global carbon budgets with reduced uncertainty for each iteration.

17. On the question of how broad such a new research initiative ought to be, a significant fraction of the individuals and programmes consulted was of the opinion that any new initiative would have to go beyond the inorganic component of the carbon cycle, and include other related biogeochemical properties such as nutrients, oxygen, and N2O, that is, consistently with the biogeochemical suite of Essential Ocean Variables developed through the GOOS Biogeochemistry Panel (provided by IOCCP). A smaller fraction of the individuals and programmes consulted was in favour of a more focused approach, mostly focused on inorganic carbon, that is, within the scope of the past SOLAS/IMBeR working groups.

18. Based on the technical assessment of the Ocean Science Section, a new initiative should also look into relevant new developments in ocean carbon research. For example, innovative work initiated in the context of SCOR Working Group 134 on the Microbial Pump in the Ocean in 2008

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and leading to the publication of a number of established studies in 2011 have emphasized the importance of the microbial pump in the global carbon cycle and in related models; its relation with eutrophication levels in coastal areas; and the need to combine established knowledge and research on the biological pump with research on the microbial pump. In light of the outline of, and the composition of experts contributing to, the IPCC Special Report on Ocean and the Cryosphere, it is likely that these issues will be reflected in the Special Report (to be published in 2019). The organization of events such as the recent Marine Microbes Gordon Research Seminar and Conference (30 June–6 July 2018) are a demonstration of the growing importance of this new body of research. IOC, in light of its longstanding role in federating research efforts related the carbon cycle, climate, and climate change may wish to take an interest and being affiliated with this emerging body of research.

19. The new focus on integrated ocean carbon research would deal with issues related to decadal variability, meso and sub-meso scale processes, scientific requirements for optimal observing system design, integrating ocean carbon biology considerations, and the interaction of the fluxes of heat and carbon fluxes and their storage.

20. Based on the developments described above, a new initiative on integrated ocean carbon is proposed under the auspices of IOC, in cooperation with IMBeR, SOLAS, GCP and IOCCP. The first step of this initiative would be to convene an expert workshop under the auspices of IOC, and in collaboration with IOCCP, SOLAS, IMBeR, GCP and others, involving 40 to 50 experts from different IOC regions, sub-disciplines (fluxes vs storage, for example), research types (observations vs models), as well as end-users (assessments, status reports). A first output of the initiative would be a synthesis report on ocean carbon: current knowledge, gaps, and related research and observation requirements. Following the successful launch of the initiative, individual programmes or specifically created task-teams would then concentrate on specific actions, depending on the alignment of certain actions with their respective terms of reference.

21. The first expert meeting under the proposed new initiative would be held at the headquarters of IOC in Paris, France, in the first quarter of 2019, pending the availability of voluntary contributions from IOC Member States. The initial outputs of the initiative would be presented at the OceanObs’19 (Honolulu, Hawaii) in September 2019 in an appropriate form.

22. The terms of reference of the proposed new initiative on integrated ocean carbon research are presented in Annex 1 of the proposed draft decision. The development of these terms of reference has benefited from informal consultations with IOCCP, SOLAS, IMBeR, GCP, WCRP/CLIVAR and US OCB.

b. The increased policy demand for ocean carbon research

23. IOC contributes to scientific and technical work underpinning the discussions by the UNFCCC and its SBSTA, particularly in the area of research and systematic observations.

24. At its 48th session held in Bonn, Germany, in April–May 2018, the SBSTA (...) encouraged Parties and relevant organizations to address gaps and needs with regard to: The role of the ocean in the global climate system, including for the global energy balance and carbon cycle, and impacts related to, inter alia, ocean acidification, sea level rise and ecosystem services, noting the proclamation by the United Nations of the United Nations Decade of Ocean Science for Sustainable Development (2021–2030), which is to be coordinated by IOC-UNESCO; (...)

25. In noting the importance of the work of the scientific community and the IPCC under the themes of the Research Dialogue, the SBSTA also encouraged Parties and relevant organizations to address gaps and needs with regard to: increasing open access to climate-relevant data; the vulnerabilities of terrestrial, marine, coastal and urban ecosystems to climate change and the value

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of ecosystem-based approaches, particularly synergies of mitigation and adaptation action and related co-benefits; the recent and ongoing rapid changes in the Arctic region; and the analysis of the global carbon cycle.

26. The SBSTA also recognized the importance of continued and enhanced support for climate change research, including enhancing research capacity, particularly in developing countries.

27. These promising conclusions follow the participation of IOC in the 10th session of the Research Dialogue convened by the SBSTA (Bonn, Germany, 3 May 2018), where representatives of IOC and a number of other science organizations (the Global Climate Observing System, GCP, IPCC, WCRP, WMO) as well as UN-Oceans were invited to provide inputs based on their respective activities on the following four themes:

(i) Science for understanding – update on research and modelling on human settlements, oceans and land and their importance for the implementation of the Paris Agreement;

(ii) Science for action – strengthening the link between the research community and action to meet the goals of the Paris Agreement;

(iii) Renewable energy economics and co-benefits;

(iv) Global research on the carbon cycle and its observation requirements in support of the Paris Agreement.

28. IOC contributed specifically to themes (i) and (ii) above, through a poster and a dedicated speaking slot at the research dialogue. IOC and the above-mentioned organizations were also invited to participate in a meeting with the Chair of SBSTA on 4 May 2018, to assess the discussions held during the Research Dialogue and provide further feedback to inform the science elements of the ensuing SBSTA deliberations.

29. The proposed new IOC-coordinated initiative on ocean carbon research would benefit from the clear policy-enabling framework described above and contribute to discussions at the science-policy interface in the content of UNFCCC. Moreover, the initiative will also assist in operationalizing the interest of UNFCCC’s SBSTA in the Decade of Ocean Science, as reflected in the SBSTA 48 decision referred to above.

IV. A new focus on multiple stressors

30. The IOC Ocean Science portfolio has a strong focus on multiple stressors affecting the world ocean, at multiple scales. One central question recurrently being asked both within the academic as well as policy circles is how ocean stressors may interact with each other, and in this regard what can be done to reduce the synergistic nature of such interaction.

31. On several occasions, IOC Member States have raised the question of knowledge on multiple stressors and its application for management. A multiple stressors approach to human-induced pressures on ocean health and ecosystem functioning is needed when facing stressors for which mitigation is not a handy option or due to the time scale of mitigation benefits.

32. Currently no integrated research programme nor an observation programme on multiple stressors exist. The IOC is uniquely placed to design and host such an initiative, due to its lead in research on ocean stressors, *inter alia*: acidification, de-oxygenation, pollution, the causes of harmful algal blooms, climate change, and habitat fragmentation and reduction.

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Moreover, multiple stressors and ecosystem-based management (EBM) have been identified as one of the preliminary objectives of the United Nations Decade of Ocean Science for Sustainable Development.

There is a need to better understand to which stressors the changes observed in the world ocean are linked (as in some cases a given observed change may be related to multiple stressors); and to discriminate between stressors that act more ‘vertically’ as the cause of a given problem and other stressors that do not act in isolation. There is also a need to foster our understanding and predicting capabilities in relation to the responses by species and changes in the functioning of, and services delivered by, ecosystems, in order to anticipate changes and their societal impacts; and to maintain ecosystem integrity.

The draft roadmap for the Decade of Ocean Sciences (IOC/EC-LI/2 Annex 3) refers to the role of research on multiple stressors research in informing EBM. Management options minimizing adverse impacts of, and maximizing opportunities for, human uses of the ocean (resources, energy, transportation – to cite a few) are largely the consequence of what we know or do not yet know about how, for example, stressors such as ocean acidification, changes in sea surface temperature and de-oxygenation interact and what their cumulative consequences may be. In essence, there is a direct link between knowledge on multiple ocean stressors and their interaction and informed management decisions, as well as marine spatial planning.

Mainstreaming a multi-stressor approach to the diagnostic analysis of ocean ecosystems will start with an appropriate research initiative on multiple ocean stressors. The initiative would entail identifying and addressing a number of research questions such as:

- Phytoplankton responses to multiple stressors (this line of research has a direct link with the IOC TrendsPO expert group);
- Impacts of multiple stressors in upwelling systems (building on the longstanding IOC-Spain project on the Canary Current Large Marine Ecosystem and on cooperation with WCRP/CLIVAR and SCOR);
- Species’ reproductive and behavioral responses to multiple stressors (capitalizing on existing efforts such as the Biological Working Group of GOA-ON);
- Integration of the multi-stressor approach in ocean modelling;
- Management requirements in relation to multi-stressor research;
- Ecosystem-level reference points related to multiple stressors;
- Development of indicators for systematic observations of multiple stressors;
- Experimental challenges related to multiple drivers experiments;
- Links between physiological responses and ecosystem impacts.

Based on the above, the IOC Executive Council may wish to call for an IOC scientific initiative on multiple ocean stressors, in collaboration with relevant organizations that are active in this area, including IMBeR and SCOR.

The terms of reference of the proposed new initiative are presented in Annex 2 of the proposed draft decision.

V. Enhanced coherence and impact of the IOC Ocean Science portfolio in support of the UN Decade of Ocean Science for Sustainable Development

The draft Roadmap for the United Nations Decade of Ocean Science for Sustainable Development (IOC/INF-1353, version 1.0 of 5 February 2018) contains two overarching goals of direct relevance to the Ocean Science portfolio and associated capacity development efforts of IOC:
generate the scientific knowledge and underpinning infrastructure and partnerships needed for sustainable development of the ocean; and provide ocean science, data and information to inform policies for a well-functioning ocean in support of 2030 Agenda.

40. Specifically, it is suggested that the Ocean Science portfolio, in its current form (cf. table in section II of the document) and with the addition of the proposed new expert initiatives on integrated ocean carbon research and on multiple ocean stressors (cf. sections III and IV of the document) will play a central role in informing the following preliminary objectives and related actions of the draft Roadmap for the Decade:

- In relation to the objective dealing with knowledge of the ocean system: the Ocean Science portfolio will continue leading the development and accelerate a coordinated programme of research on ocean acidification; it will coordinate the development of integrated research plans on ocean carbon responding to requirements for ocean science stemming from the IPCC Special Report on the Oceans and Cryosphere and the UNFCCC, thus also contributing to an enhanced uptake of ocean science knowledge at the science-policy interface;

- In relation to the objective dealing with multiple stressors and evidence for ecosystems-based management and blue economy: the Ocean Science portfolio will lead a global programme of research on multiple ocean stressors to inform EBM, building on its demonstrated expertise and current work on the following ocean stressors: acidification, de-oxygenation, harmful algal blooms, plastics and microplastics, and nutrients and eutrophication;

- In relation to the objective dealing with ocean-related hazards: the Ocean Science portfolio will continue leading a global programme of research and communication on causes of occurrences of harmful algal blooms and related health impacts;

- In relation to the objective dealing with scientific and technical capacity and education: the Ocean Science portfolio, through the GOSR, continues providing strategic advice to national contributions directed towards strengthened and directed capacity building activities linked to technology transfer, including new technologies;

41. The continuous evolution of the Ocean Science portfolio and the alignment of current and planned activities with the preliminary goals and objectives of the Decade of Ocean Science call for reorienting some of the current activities in adjusted directions. Specifically, it is proposed that:

- In relation to GESAMP WG 41 (marine geoengineering), IOC’s future role in the working group be assessed further, also in light of opportunities presented by the Decade of Ocean Science in relation to gathering sound scientific information on marine geoengineering and conducting investigations in this area;

- In relation to the IGMETS Working Group, that, when reconvened\(^5\), it be invited to include WCRP/CMIP in the list of existing networks and activities with which it will liaise\(^6\) in order to explore, as appropriate, how ecological time series can contribute to inter-compared coupled modelling tools for prediction of ocean conditions.

42. The IOC Secretariat will report to the 30\(^{th}\) session of the IOC Assembly (2019) on developments related to IOC’s involvement in GESAMP WG 41 and the collaboration between IGMETS and WCRP/CMIP.

43. On the other hand, the current thematic clusters of the Ocean Science portfolio remain generally valid. It is proposed that a slight redistribution of the current and planned activities into these clusters take place, as indicated below:

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\(^5\) The IOC Secretariat plans to organize the next meeting of IGMETS in the last quarter of 2018.

\(^6\) Term of reference (v) of IGMETS (cf. IOC/EC-XLIX/2 Annex 6) lists the following networks and activities with which IGMETS is asked to align: GOOS, JCOMM, GOA-ON, OBIS, IOC-HAB, GO2NE, ICES working groups, PICES, OCB, NOAA, sMARINE, IOCCP, and GEOBON.
- Cluster 'Ocean-related climate research at the service of society': it is proposed that this cluster will continue encompassing one central activity, the WCRP, in light of strategic considerations related to the evolution of WCRP and the role of IOC in WCRP design and implementation (cf. IOC/INF-1342 Part 2);

- Cluster 'Ocean carbon sources and sinks': it is proposed that this cluster host the new initiative on integrated ocean carbon research, including the related contribution of TrendsPO; and an expanded focus on BCI, specifically on the contribution of blue carbon to Nationally Determined Contributions under the UNFCCC Paris Agreement;

- Cluster 'Impacts of climate change and other stressors on ocean and coastal ecosystems': it is proposed that this cluster focuses on expert work related to GOA-ON (ocean acidification), GO2NE (de-oxygenation), HABs, GESAMP WG 40 (plastics and microplastics), and work related to SDG indicator 14.1.1 (nutrients and eutrophication), as well as that it host the new initiative on multiple ocean stressors.

44. It is worth noticing that GOSR will continue cutting across all of the above-mentioned clusters of activities and playing a critical role in relation to Function E on capacity development.

45. It is also suggested that further synergies will be built between relevant underpinning work under the Ocean Science portfolio and the Essential Observing Variables of GOOS, especially in relation to the GOOS Biology Panel. An activity requiring attention by the Ocean Science Section is the further development of the Global Bathymetric Chart of the Oceans (GEBCO), with specific regard to scientific matters requiring elucidation. Finally, the Ocean Science Section looks forward to playing a primary role in the development of the science plan of the Decade of Ocean Science in due course.

46. This streamlined structure of the Ocean Science portfolio aims mainly at contextualizing existing (and new) activities to the SDGs and the Decade of Ocean Science. While in itself it does not necessarily require endorsement by the IOC Executive Council in light of its being part of how the IOC Secretariat packages the priorities set by Member States in the daily execution of the IOC programme of work, nevertheless it is important that Member States are aware of it, in a spirit of continuous dialogue between IOC Member States and the IOC Secretariat.

47. It should be noted that the proposed two new expert initiatives reflect the need for the generation of knowledge needed to fill critical gaps in our understanding of the carbon cycle and budget; and in supporting sound management decisions based on mitigation of and adaptation to multiple ocean stressors in an era of global change. As such, they would respond to a clear and strong demand for such knowledge on behalf of both the scientific as well as the policy community, in a timely, relevant and salient manner. Initiating these new initiatives merely within the existing regular programme budgetary envelope would not lead to the desired results. The Ocean Sciences Section will therefore engage in a dialogue with interested donor Member States on the possible co-design of such initiatives and the provision by the latter of the necessary extrabudgetary resources to implement this intended new expert work as part of the IOC Ocean Science portfolio.

**Proposed decision**

48. In light of the foregoing, the IOC Executive Council may wish to consider the following proposed decision:

**IOC/EC-LI, Dec.4.2**

The IOC Executive Council:

1. **Having considered** document IOC/EC-LI/2 Annex 5,
2. Recognizing that in light of the highly dynamic nature of ocean science, there is a need to ensure the continuous coherence and impact of the IOC Ocean Science portfolio by reflecting relevant scientific developments in ocean science,

3. Recalling the importance of the world ocean in the climate system and the continuous need for coordinated ocean carbon research to support scientific advances and to respond to relevant requests for knowledge by the policy community,

4. Endorses the development of a new initiative on integrated ocean carbon research, in close cooperation with IOCCP, SOLAS, IMBeR, GCP, WCRP/CLIVAR and other relevant partners active in carbon research, in the form of a dedicated IOC working group with Terms of Reference provided in Annex 1;

5. Decides to capitalize on the efforts of IOC working groups focusing on individual ocean stressors in the form of a new IOC working group on multiple ocean stressors in support of ecosystem based management with Terms of Reference provided in Annex 2;

6. Invites Member States to contribute financial resources as well as other in-kind contributions in support of the newly created two working groups;

7. Expresses its appreciation for the strategic alignment of the Ocean Science portfolio with the United Nations Decade of Ocean Science for Sustainable Development planning process and the unfolding work related to the implementation of relevant goals and targets of the 2030 Agenda on Sustainable Development, so as to enhance the contribution of the IOC activities in ocean science to the sustainable development agenda.

Annex 1 to Decision EC-LI/4.2

Terms of Reference of the IOC Working Group on Integrated Ocean Carbon Research

1. The IOC Working Group on Integrated Ocean Carbon Research (hereinafter referred to as ‘the Working Group’) aims at filling knowledge gaps in relation to ocean carbon by designing and promoting the implementation of the new generation of integrated ocean carbon research.

2. The Working Group, coordinated by IOC, will foster active collaboration and synergies amongst IOC, the International Ocean Carbon Coordination Project (IOCCP), the Surface-Ocean Lower Atmosphere Study (SOLAS), the Integrated Marine Biosphere Research (IMBeR), the Global Carbon Project (GCP), the core project on Climate and Ocean Variability, Predictability and Change (CLIVAR) of the World Climate Research Programme (WCRP), and relevant national efforts on carbon research. The Initiative is open to any other relevant international efforts on ocean carbon research with a demonstrated scientific record.

3. The Working Group will be composed of approximately 20-25 experts. The core of the Group will be constituted by two experts designated by each partner (IOC, IOCCP, SOLAS, IMBeR, GCP, WCRP/CLIVAR), which will act as the Working Group’s Steering Committee (SC). The SC will identify additional experts for their inclusion in the Working Group. The SC will identify and appoint two members of the Working Group as Co-Chairs of the Group. Membership of the group will last two years; while members of the Working Group could be prolonged for a second two-year term, it is envisaged that at the end of the first term, one third to half of the group be renewed by appointing new members.

4. The Working Group will have a geographic and gender balanced representation, reflecting inter alia the following disciplines and areas of ocean carbon research: ocean physics, chemistry, biochemistry, biology, ecology and technology.

5. Depending on scientific needs, the Working Group may establish task teams around specific themes or crosscutting issues related to various aspects of ocean carbon research. These task teams would be co-chaired by two members of the Working Group, taking into due account geographic and gender balance.
6. The Working Group will build upon the multiple relevant synthesis activities for ocean carbon and promote coordination across these efforts. These syntheses will inform the organization of research efforts on ocean carbon research at multiple levels – national, regional and global.

7. The findings of the Working Group may contribute to the sixth assessment report of the IPCC (IPCC AR6) and other IPCC reports, as appropriate, and according to the IPCC rules of procedure (e.g. through the peer-review process of the AR6 and other IPCC reports). The Working Group, in coordination with the UNFCCC Secretariat, may also assist in facilitating informal consultations among science organizations invited to contribute to research dialogues convened by the UNFCCC.

8. The Working Group will develop a yearly work plan, review it on a yearly basis, and report, through the IOC Secretariat, to the IOC Governing Bodies on progress made in the discharge of its functions 7.

9. The Working Group will produce its findings in the form of meeting reports, scientific articles, science plans and implementation plans. It will also assist the IOC Secretariat in producing policy briefs and public awareness materials, as appropriate, including dedicated web pages as part of the IOC website.

10. A Working Group secretariat will be provided by the Ocean Sciences Section of the IOC Secretariat. Collaborating organizations, programmes and initiatives may also provide staff or in-kind contributions, including secondment of experts, to support the Working Group secretariat.

11. The Working Group will operate on the basis of voluntary financial and in-kind contributions of IOC Member States, other governments, and international organizations.

Annex 2 to Decision EC-LI/4.2

Terms of Reference of the IOC Working Group on Multiple Ocean Stressors

1. The IOC Working Group on Multiple Ocean Stressors (hereinafter referred to as ‘the Working Group’) aims at identifying main ocean stressors and their interaction, with a view to elucidate possible actions related to ecosystem based management (EBM).

2. The Working Group will be composed of approximately 20 experts, the bulk of whom will be provided by the co-chairs of relevant IOC working groups (GOA-ON, GO2NE, HABs, TrendsPO, BCI, GESAMP WG 40 and nutrients), with the addition of expertise, including EBM, with a geographic and gender balanced representation. Two members of the Working Group will act as Co-Chairs of the Group.

3. The Working Group will produce a synthesis report in 2019, aimed at informing work under the United Nations Decade of Ocean Science for Sustainable Development relevant to multiple stressors and EBM.

4. The Working Group may produce scientific articles, and will be asked to produce technical reports, on inter alia:
   a. Experimental challenges related to multiple drivers experiments
   b. Links between physiological responses and ecosystem impacts

7 Initial activities of the Working Group foreseen to start in the last quarter of 2018 may entail:
   a. An inception meeting of the Working Group in early 2019
   b. Coordinated contributions to WCRP Coupled Model Intercomparison Project (CMIP6) activities as a follow-up to the CMIP6 workshop on ocean carbon uptake (AGU, 2018), in coordination with CMIP
   c. Inputs to relevant ocean acidification activities in relation to the work plans of GOA-ON and the IAEA Ocean Acidification International Coordination Centre (OA-ICC), in coordination with GOA-ON
   d. Inputs to the GCP REgional Carbon Cycle Assessment and Processes (RECCAP) 2 meeting (Japan, March 2019)
c. Ecosystem-level reference points related to multiple stressors
d. Development of indicators for systematic observations on multiple stressors
e. Integration of the multi-stressor approach in ocean models and predictions
f. Management requirements in relation to multi-stressor research.

5. The Working Group may be called upon to assist the IOC Secretariat in producing policy briefs and public awareness materials, as appropriate, including dedicated web pages as part of the IOC website.

6. The Working Group will review its work plan on a yearly basis and report, through the IOC Secretariat, to the IOC Governing Bodies on progress made in the discharge of its functions.

7. A Working Group secretariat will be provided by the Ocean Sciences Section of the IOC Secretariat. Collaborating organizations, programmes and initiatives may second staff to support the Working Group secretariat.

8. The Working Group will operate on the basis of voluntary financial and in-kind contributions of IOC Member States, other governments, and international organizations.