

96

REPORTS AND STUDIES



GESAMP

Joint Group of Experts on the
Scientific Aspects of Marine
Environmental Protection

REPORT OF THE 44th SESSION OF GESAMP

Geneva, Switzerland, 4 to 7 September 2017



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**REPORT OF THE
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Notes

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EXECUTIVE SUMMARY

0.1 **Introduction:** The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) held its 44th session hosted by the World Meteorological Organization (WMO) in Geneva, Switzerland, from 4 to 7 November 2017. GESAMP was established in 1969 by a number of United Nations Organizations as a Joint Group to encourage the independent, interdisciplinary consideration of marine pollution and environmental protection problems with a view to avoiding duplication of efforts within the United Nations system. The main topics considered at this session are described below.

0.2 **Evaluation of the hazards of harmful substances carried by ships (WG 1):** This working group (WG) evaluates, at the request of the International Maritime Organization (IMO), the hazards to the environment and human health of bulk liquid chemicals carried by ships, with over 900 hazard profiles currently on record. The hazard profile contains a unique fingerprint of each substance, providing information on 14 separate human health, environmental, and physico-chemical hazard criteria. WG 1 met once since GESAMP 43, evaluating 13 new substances to assign full GESAMP Hazard Profiles. Furthermore, 33 additional substances were re-evaluated. In addition, there is an ongoing review and consolidation of information held in the WG's database that has resulted in a series of updates and amendments to some existing profiles. GESAMP noted the working group's intention to revise the existing hazard evaluation procedure and finalizing a new Reports and Studies publication.

0.3 **Review of applications for 'active substances' to be used in ballast water management systems (WG 34):** GESAMP noted that the Ballast Water Management Convention will enter into force on 8 September 2017. WG 34 convened twice since GESAMP 43, to discuss and evaluate three ballast water management systems. Of these systems, two received recommendations for Basic Approval and one received recommendation for Final Approval. GESAMP stressed the need for the publication of the Report and Studies publication to inform scientific work in the area of risk assessment. WG 34 also held its 8th stocktaking workshop (STW 8) in February 2017.

0.4 **Atmospheric input of chemicals to the ocean (WG 38):** The WG has published six scientific papers under its new terms of reference, one more has been submitted for publication and a seventh will be submitted for publication this fall. Following the completion of the publication of the papers resulting from the 2013 workshop on the impacts of atmospheric nitrogen deposition to the ocean, the working group has prepared a synthesis of the results from the scientific papers derived from that workshop as part of the GESAMP Reports and Studies series. That draft report was reviewed by GESAMP, and WG 38 will consider the comments received as they prepare a final report to be published by the end of 2017. Three workshops were initiated on new WG activities and approved in 2015 to: (a) investigate the changing acid/basic character of the global atmosphere and ocean; (b) investigate the impact of these changes on certain air/sea chemical exchange processes; and (c) conduct

an assessment of the impact of nitrogen on the marine environment as a contribution to the Integrated Nitrogen Management System (INMS). A potential upcoming activity of the group is to conduct an assessment of the impact of nitrogen in the marine environment. GESAMP noted that 12 papers were being developed for publication as an outcome from the workshop discussions.

0.5 **Establishment of trends in global pollution in coastal environments (WG 39):** The purpose of this WG is to contribute to the reduction of stress in the coastal ecosystem by providing stakeholders, scientists and society with an objective and global assessment of pollution trends over the last century in sensitive coastal ecosystems. Outputs are expected to include a bibliographic database, a methodology for the retrospective analysis of pollution history, a global report including details on pollution trends in Large Marine Ecosystems (LMEs), a webpage, peer-reviewed papers and a final report to be produced by the end of 2018.

0.6 **Sources, fate and effects of plastics and microplastics in the marine environment (WG 40):** This working group was initiated in 2012, so far producing two reports in the GESAMP Reports and Studies Series: No. 90 in 2015 and No. 93 in late 2016. The Terms of Reference (ToRs) were revised during the intersessional period and the group's membership renewed. It was agreed to include macro-plastics within the WG ToRs, with a consequent amendment to the name of the group. The results of TOR 1, focused on producing guidance on harmonized monitoring and assessment, will be made available in a publication by December 2018. Funding opportunities to support the activities of the group will be further explored.

0.7 **Marine geoengineering (WG 41):** GESAMP noted that since the last session, the WG held its second meeting which took place from 26 to 28 April 2017 at the WMO Headquarters in Geneva, Switzerland. Following extensive discussion, the working group decided to select an illustrative approach across each of eight distinct geoengineering categories and reduce the evaluation criteria due to lack of information. It was also decided that the appraisal process needed to include additional disciplines in order to become more relevant to decision makers. The need to expand the group's work for another year was highlighted in order to produce an authoritative scientific assessment on marine geoengineering approaches. GESAMP noted the timeline for finalization of the group's report by the first quarter of 2018 and requested that the UNFCCC is informed by the GESAMP Office of the group's work.

0.8 **Impacts of wastes and other matter in the marine environment from mining operations, including marine mineral mining (WG 42):** This is a newly formed working group on the environmental impacts of mine tailings discharged into the marine environment and sea bed mining. The group had already discussed the report structure, timetable and set dates for its first meeting. GESAMP revised the first ToR for the working group in order to ensure clarity on how the working group would identify and provide a better understanding of both commonalities and differences in the potential environmental impacts of

mine tailings discharge into the marine environment and sea bed mining.

0.9 Contribution to other UN processes:

GESAMP confirmed its intent to follow closely developments of the UN Regular Process so as to identify opportunities to contribute to the second cycle of the World Ocean Assessment. GESAMP will consider the outcome of the UN Ocean Conference (June 2017) and consider ways it can contribute to the implementation of the 2030 Agenda for Sustainable Development. The initiative for the development of an International Decade of Ocean Science for sustainable development was also presented, by IOC-UNESCO, and GESAMP expressed its intent to partner with others in the development and implementation of the Decade.

0.10 Side event on 'Carbon dioxide in the atmosphere-ocean system: impacts and feedbacks:

GESAMP and WMO organized a special side event. The session, which was attended by approximately 25 people, was intended to enhance knowledge of the current understanding of global carbon, the impacts of CO₂ and related stressors to the ocean ecosystem and ocean feedbacks in the climate system. The participants also considered how this ties in with GESAMP's existing and/or future work.

0.11 Identification of new and emerging issues regarding the degradation of the marine environment:

The issue of deep sea mining and its impacts on the marine environment was discussed and in particular the advantages in GESAMP's relationship with the International Seabed Authority as a sponsoring agency for WG 42. Issues arising from the work of the group would be discussed in future sessions.

0.12 Scoping activities:

GESAMP considered the progress of five Correspondence Groups that had been developing scoping papers in the intersessional period: CG 1 - The environmental impact of disinfection by-products; CG 2 - The impacts of chronic hydrocarbon contamination; CG 3 - The causes and impacts of massive outbreaks of Sargassum seaweed in the Caribbean, Brazil and West Africa; CG 4 - The impact of pharmaceutical and other novel chemicals in wastewater; CG 5 - The extent and impacts of onshore and offshore sand mining. In addition, GESAMP agreed to establish a correspondence group to prepare a scoping paper on possible options for updating the overview of main sources of pollution in the marine environment, in particular to re-visit the often quoted figure that 80% of marine pollution originates on land.

0.13 GESAMP agreed on the expansion and/or revision of the scoping papers in order to provide more defined focus on the issues explored. The group also agreed on the membership of the correspondence groups assigned to work on the various papers.

1 INTRODUCTION

1.1 The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) held its 44th session from 4 to 7 September 2017, in Geneva, Switzerland, hosted by the World Meteorological Organization (WMO). The session was held under the Chairpersonship of Mr Peter Kershaw, with Mr Manmohan Sarin as Vice-Chairperson. The session was preceded by the GESAMP Executive Committee (ExCom) meeting and an informal meeting of the GESAMP members, both held on 4 September 2017.

Adoption of the agenda

1.2 The meeting approved the provisional agenda, which is attached as Annex I to this report. The list of documents submitted to this session is shown in Annex II to this report and the list of participants in Annex III.

1.3 Mr Petteri Taalas, Secretary-General of WMO, welcomed GESAMP to Geneva and the 44th session of GESAMP. In his welcoming remarks, Mr Taalas highlighted the importance of science in the context of understanding the ocean-climate interface, but also in relation to the Paris Agreement.

1.4 The Chairperson expressed GESAMP's gratitude to WMO for hosting the session and for the excellent arrangements made in preparation for the meeting.

2 REPORT OF THE CHAIRPERSON OF GESAMP

2.1 The Chairperson reported that it had been another busy and productive period for GESAMP. The main focus, since the 43rd session, had been on the planned activities of the working groups. A new working group (WG 42) had been initiated since the 43rd session, on assessing impacts of sea disposal of mine wastes. The Chairperson attended, in person and remotely, meetings of WG 38, WG 41 and WG 42 to explain the purpose, function and structure of GESAMP to WG members, and offer support or advice as appropriate.

2.2 The Chairperson noted that the continuing support from the UN Sponsoring Organizations was greatly appreciated, and urged that this level of support should be maintained and, if possible, increased. The independence, credibility and cost-effectiveness of the GESAMP model was well recognized and the continuing delivery of high quality outputs was greatly appreciated by the target audience and a much wider user-group. This can only be maintained with continuing support from the UN Sponsoring Organizations, financially and in-kind. It was encouraging to see the efforts being made to maintain or increase this support by agencies but also to note the success in securing funding from a diverse range of sources for particular working group activities.

2.3 In recent years intersessional correspondence groups have addressed several important issues to help evaluate whether these are areas GESAMP may wish to develop further. Currently these include:

- CG 1 - The environmental impact of disinfection byproducts;
- CG 2 - The impacts of chronic hydrocarbon contamination;
- CG 3 - The causes and impacts of massive outbreaks of *Sargassum* seaweed in the Caribbean, Brazil and West Africa;
- CG 4 - The impact of pharmaceutical and other novel chemicals in wastewater; and
- CG 5 - The extent and impacts of onshore and offshore sand mining.

2.4 The correspondence groups are discussed further under Section 7.

2.5 GESAMP acknowledged the continuing support of the GESAMP Office, including the contribution of the GESAMP Administrative Coordinator. This year marked the retirement of Mr Edward Kleverlaan as Technical Secretary for IMO. His contribution was warmly acknowledged by GESAMP and we wish him a happy retirement. The Office continues to receive ad hoc requests for GESAMP to contribute to UN, intergovernmental and regional initiatives, as well as less formal requests for advice or support. It is encouraging to see that GESAMP is seen as a source of reliable information and advice.

2.6 The status of the Pool of Experts, and efforts to maintain and improve communication with those experts who have shown an interest in GESAMP, have been discussed at recent GESAMP sessions but without resolution. The Office would welcome suggestions on how communication might be improved in this respect.

GESAMP and the wider community

2.7 The United Nations SDG 14 Ocean Conference was the most important event to have occurred in relation to GESAMP's mission, since the 43rd Session. It took place from 5 to 9 June 2017 in New York. The Chairperson was invited as a panel member at the first Partnership Dialogue plenary sessions covering marine pollution. There was considerable interest to this issue, with the main focus on marine plastic litter, although the Chairperson did attempt to place this in a broader environmental protection context. There were several other invitations to present at or attend side events concerned with marine litter, regional governance and the role of science in policy development. The importance of linking SDG 14 with other SDG goals was emphasised on several occasions. The conference presented an excellent opportunity to raise GESAMP's profile to a varied global audience, including discussion with the environment ministers of Norway, Sweden and Indonesia. The Chairperson expressed his gratitude to IMO for supporting his active involvement in the conference.

2.8 The Chairperson was invited to attend the consultation on the implementation of the EAF Nansen science programme, hosted by FAO in February 2017. This programme provides the opportunity to make observations of several parameters in the areas of ocean physics, chemistry and biology, and extend environmental monitoring of contaminants, to areas of the ocean that are less well frequented by commercial and research vessels, as well as to improve local capabilities. This applies in particular to the west coast of Africa, the east coast of South America and the southern Indian Ocean in the next 2 to 3 years. This may also provide opportunities to identify regional experts in relation to GESAMP's existing or future work programme.

2.9 The Chairperson attended a workshop on microplastics in seafood at the invitation of FAO, in December 2016, in support of the UN Environment-funded initiative to produce a report on this important topic. This was a good opportunity to make sure that the work of WG 40 was well integrated.

2.10 The Chairperson attended one workshop of the G7 (Rome, with Regional Seas organizations) and two workshops of the G20 (Hamburg, Bremen) in relation to the preparation and implementation of their respective Action Plans on marine litter. Contacts made at these meetings have led to agreements between GESAMP and Northwest Pacific Action Plan (NOWPAP) and the Environment Ministry of Japan and the State Oceanic Administration of China for each to sponsor one member for the third phase of WG 40.

Action by GESAMP

2.11 GESAMP continues to be recognized as a source of reliable and impartial science assessment and advice. This accolade can only be maintained if there is sufficient support and financial backing for a vibrant programme, that provides a cost-effective service for the agencies and responds to requests from external bodies to contribute GESAMP's experience and expertise. There appear to be two components to ensure GESAMP can thrive:

- .1 for the Sponsoring Organizations to commit to supporting GESAMP both in terms of sponsoring members to attend the annual session and by offering financial support for the working group and other ad hoc activities.
- .2 to pursue partnerships between Sponsoring Organizations and external funding bodies such as industry, foundations, intergovernmental bodies, national governments and NGOs.

3 REPORT OF THE ADMINISTRATIVE SECRETARY OF GESAMP

Outcome of the meeting of the Executive Committee of GESAMP (ExCom)

3.1 GESAMP noted that ExCom had met on Monday 4 September 2017. The main points of discussion are shown in paragraphs 3.2 to 3.4 below.

Funding

3.2 ExCom discussed the financial and in-kind support, which the nine Sponsoring Organizations of GESAMP committed to support the activities of GESAMP in 2017-2018. ExCom noted that the Sponsoring Organizations present, intended to, as a minimum, continue their support to the level of the previous years. The ExCom also discussed outreach activities to potential additional new Sponsoring Organizations and noted with great appreciation that the International Seabed Authority (ISA) was attending the session as an observer.

3.3 The ExCom also discussed the progress with the implementation of the communications and outreach plan developed last year, and noted that the GESAMP Office were in the final stages of developing a new website for GESAMP. The website would, following input by the ExCom and others, be launched before the end of the year.

The GESAMP Office

3.4 The IMO Technical Secretary for GESAMP informed the meeting of the latest developments in the GESAMP Office, which is hosted at IMO as a co-sponsoring arrangement between the Sponsoring Organizations. GESAMP noted that the GESAMP Office continues to provide administrative support and coordination to GESAMP activities and its working groups and that since the last session, the main activities of the GESAMP Office had been the following:

- .1 supporting the activities of the existing working groups of GESAMP, including the various peer-review activities;
- .2 implementation of the GESAMP funding strategy, in coordination with the Chairperson of GESAMP;
- .3 assisting in the publication of several GESAMP reports;
- .4 development of the new GESAMP website;
- .5 implementation of the communications plan; and
- .6 preparation of the current session of GESAMP.

Activities and achievements of the Sponsoring Organizations of GESAMP since its last session

3.5 GESAMP considered the Administrative Secretary's report (GESAMP 44/3). The Administrative Secretary also presented an overview of the activities and achievements of the Sponsoring Organizations of GESAMP since GESAMP 43 in 2016. The highlights of these achievements are reported in detail in Annex IV to this report.

Action by GESAMP

3.6 GESAMP noted that the information contained in the report of the Administrative Secretary is unique, as it provides a succinct but comprehensive overview of

the work of the nine Sponsoring Organizations in the field of marine environmental protection, and the scientific aspects in particular. As such, it was proposed that as part of the development of the new website and general outreach efforts, it would be useful to highlight these annual reports to the general public, for example through the website.

4 PLANNING OF GESAMP ACTIVITIES

4.1 Evaluation of the hazards of harmful substances carried by ships (WG 1)

4.1.1 A report of the activities of Working Group 1 (WG 1) was given by Mr Thomas Höfer, Chairperson of the working group.

4.1.2 GESAMP noted that since the last meeting of GESAMP, WG 1 had met once. The 54th session (EHS 54) was held in London from 22 to 26 May 2017. The full report has been published as EHS 54/9 and circulated as IMO circular PPR.1/Circ.4.

Main use of GESAMP/EHS outputs

4.1.3 As outlined in the previous report to GESAMP, the GESAMP Hazard Profiles (GHP) developed by WG 1:

- .1 contain a unique fingerprint for each substance, providing information on fourteen separate human health, environmental and physico-chemical hazard criteria and consist of an alphanumeric notation designed to communicate the hazards;
- .2 are published by IMO annually as the GESAMP Composite List (circulated together with the meeting report as a PPR.1/Circular), which are placed on the IMO website for the use of maritime Administrations, the shipping industry and chemical manufacturers; and
- .3 provide the basis for the pollution categorization of over 900 substances. MARPOL Annex II and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) utilise these profiles to determine the pollution category, ship type and carriage conditions for each chemical, for the purposes of bulk carriage in ships.

4.1.4 GESAMP noted that the latest draft version of the Chapter 21 of the International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code) makes direct reference to GHP ratings for all carriage conditions including environmental protection, ship safety, and occupational health. It is expected that the amendments to the IBC Code, with these new references to the GESAMP hazard ratings, will be adopted next year and will enter into force by 2020. This regulatory background needs an enhanced and more detailed evaluation of hazards to human and environmental health by the working group.

4.1.5 The ongoing work on revising Chapter 21 of the IBC Code, which updates the hazard classification criteria used for assigning carriage requirements, presents new challenges for the GESAMP Hazard Evaluation Procedure. The new Code of Safe Practice for the Carriage of Cargoes and Persons by Offshore Supply Vessels (OSV Code), which will become a mandatory requirement, includes direct reference to the IBC Code, including the GESAMP Hazard Profile. Whereas the IBC Code asks for a more sophisticated evaluation of the inhalation hazard, the offshore supply regulation relies heavily on a realistic scientific evaluation of mineral slurries.

4.1.6 It was noted that a scientific evaluation of the flammability and explosion hazard with the assignment of a rating within the GESAMP Hazard Profile would be a useful addition for use by the IMO Working Group on the Evaluation of Safety and Pollution Hazards of Chemicals (ESPH). Although the GESAMP/EHS Working Group evaluates the scientific data, no rating for flammability is currently included as part of the GESAMP Hazard Profile.

4.1.7 GESAMP was informed that extended and more sophisticated guidance for the evaluation and the hazard ratings is now needed, after more than 15 years of work based on the guidance published in 2002 as Reports & Studies No. 64. This future procedure will include a more detailed evaluation of the vapour inhalation hazard, the flammability hazard will eliminate the rating for tainting (which is now considered obsolete) and will revise the procedure for the assessment of hazards for inorganic substances. The revision of the guidance had already been agreed in principle by GESAMP 43 in 2016.

4.1.8 During the 53rd session in 2016, WG 1 had initiated discussions on possible future amendments to the existing guidance developed first drafts intersessionally, and finalized draft texts and rationales during the 54th session in 2017 (shown as Annexes 4, 5 and 6 of the report EHS 54/9).

4.1.9 GESAMP noted that the WG had reconfirmed its intention to initiate a revision of the second edition of Reports and Studies No.64 for finalization and publication to coincide with the 50th anniversary of GESAMP in late 2019.

Evaluation of substances

4.1.10 The main work carried out at the 54th session of WG 1 concerned the evaluation of substances, as per the usual practice. Data on 13 new substances were evaluated and full GESAMP Hazard Profiles (GHPs) assigned, accordingly. Based on correspondence with industry, 33 additional substances were submitted for re-evaluation. The GHPs for 9 substances were either modified or reconfirmed, based on consideration of new data.

4.1.11 Industry submitted information about inhalation toxicity for 24 chemicals which, in most cases, was insufficient for any final assessment. However, guidance was provided for industry for better submissions, e.g. if data are based on read across or by analogy, a clear rationale and explanation would be needed. This work is a direct result of the new policy

under the IBC Code including a direct reference to GESAMP ratings. As many of the 900 chemicals evaluated during the last decades are less toxic via vapour than via mist (aerosol) exposure. A revised rating could lower the standards for carriage requirements leading to significantly lower transport costs.

4.1.12 Together with the WG's consideration of the submissions for a number of new products, the situation led to a general discussion regarding the quality of submissions, in particular, with regard to the format for submission of test studies and supporting technical data. To this end, the WG agreed that guidance was needed which clearly set out the type and format of information to be submitted for both new products and re-assessments and had requested the Secretariat to develop this intersessionally for review at EHS 55 (in 2018).

4.1.13 An important issue concerned the evaluation of hydrocarbon waxes including paraffin-like products which are washing up on beaches along European coasts. Based on the information considered at EHS 53, the WG concluded that there were four possible groupings for paraffins and agreed to further refine these and develop appropriate names and profiles at EHS 54. Taking into consideration the background documentation prepared by the Chairperson intersessionally noting that no information had been received from industry, further to the request made by IMO bodies (ESPH 22 and PPR 4), the WG agreed to revised entries for paraffins and hydrocarbon waxes in the Composite List.

Membership issues

4.1.14 The WG had invited Ms Bette Meek to formally join GESAMP/EHS as a standing member of the expert group, further to her initial participation as a first time expert at GESAMP/EHS 53, and welcomed her important contribution to the WG's work going forward. The WG also noted that this would be the last session of Mr Derek James and expressed its deep appreciation for his long and dedicated service to the work of the WG.

Funding issues

4.1.15 GESAMP recalled that the funding of WG 1 is based on a fixed fee, which is charged for each new product evaluation. It was noted, however, that to date no fees were applied for cases where requests from industry for a revised hazard evaluation were submitted. As reported following discussions at GESAMP 42, GESAMP noted that the level of effort involved in these re-evaluations was considerable and increasing and, as a consequence, that consideration should be given to the introduction a fee for this service, as is done for the full assessments. The responsible IMO bodies agreed to request the GESAMP/EHS Working Group to continue monitoring this issue and report back, as appropriate. It should be noted in this respect that GESAMP/EHS 54 considered an exceptionally large number of submissions for re-evaluation in particular of the acute inhalation hazard.

Action by GESAMP

4.1.16 GESAMP noted the WG's intention to revise the existing hazard evaluation procedure, aiming at finalizing a new GESAMP Reports and Studies publication in time for GESAMP's 50th anniversary in 2019. GESAMP also noted the concerns regarding the membership and funding issues.

4.2 Review of applications for "active substances" to be used in Ballast Water Management systems (WG 34)

4.2.1 A report of the activities of WG 34 was given by Mr Jan Linders, Chairperson of the working group.

4.2.2 GESAMP noted that the International Convention for the Control and Management of Ships' Ballast Water and Sediments, (hereafter referred to as the BWM Convention) was adopted at IMO on 13 February 2004, in response to the increasing concern of the international community with regard to the transfer of invasive species in ships' ballast water. On 8 September 2017, the Ballast Water Management Convention will enter into force. The number of Contracting Governments was, as of 4 September 2017, 63 contracting Parties representing 68.51%.

4.2.3 Within this framework, an approval procedure has been set up for those ballast water management systems which make use of an Active Substance or Preparation to comply with the Convention. The procedure consists of a two-step approach for granting Basic Approval and Final Approval. The approval is granted by the Marine Environment Protection Committee (MEPC) based on the advice provided by the Ballast Water Working Group of the GESAMP (WG 34). There is a third step, the type approval, but that is outside the remit of WG 34.

4.2.4 The more general outline, scope and aim of the BWM Convention have been addressed in the report to the GESAMP 35 (see document GESAMP 35/5/1) and will only be referred to here. As the terms of reference of WG 34 have not changed, several parts of this report have been kept unchanged.

4.2.5 The report of the Chairperson of WG 34 report therefore focused on the main activities of the working group, which consist of the evaluation of several ballast water management systems (hereafter BWMS) and the further development of the Methodology of the group, which has been accepted as a 'living' document. This means that the Methodology will be a discussion item at (almost) each meeting of the group and changes and improvements are made, as appropriate (see further below).

"Active Substances"

4.2.6 "Active Substances" are defined by the Convention as "substances or organisms, including a virus or a fungus that have a general or specific action on or against harmful aquatic organisms and pathogens" and the approval of BWMS using such substances is described in resolution MEPC.169(57) adopted in 2008. However, not only 'Active Substances' are evaluated by the WG 34. Also all other substances considered relevant are taken into account in the

evaluation report. The Procedure for approval of ballast water management systems that make use of Active Substances (G9) contained in resolution MEPC.169(57) under the BWM Convention distinguishes also “Relevant Chemicals” and “Other Chemicals”.

4.2.7 Therefore, WG 34’s task is to evaluate the risks for the crew, the ships’ safety, the risk for the public at large and the environmental safety of the BWMS. It is furthermore the intention of WG 34 to perform these evaluations in a consequent, consistent and transparent manner, which helps Administrations to prepare a concise dossier, containing all the necessary data. The Methodology, as developed by WG 34 in the course of its work process, serves as guidance in the evaluation.

4.2.8 WG 34 convened two times since GESAMP 43 to evaluate proposed BWMS, one time for a regular meeting from 5 to 9 December 2016, where 3 BWMS have been evaluated, and one time for its 8th Stocktaking Workshop (STW) from 6 to 10 February 2017. Of these BWMS, two received a recommendation for Basic Approval and one received a recommendation for Final Approval. During its meeting in July 2017, MEPC agreed with the recommendations of WG 34 in all cases and granted the approvals accordingly.

4.2.9 WG 34 was able to clear the whole stock of BWMS submitted for evaluation before the meeting of MEPC for which the evaluation was requested. The group recognized that the number of BWMS presented to the group have been less than in other reporting periods. It is expected that this has close relation to the ongoing process in IMO to modify Guidelines (G8) for receiving type approval from Administration (see paragraph 4.2.11).

Methodology for information gathering and the conduct of work of WG 34

4.2.10 The evaluation Methodology of WG 34 has been determined to be a living document based on increasing experience in the evaluation of BWMS. During eight Stocktaking Workshops WG 34 further developed the Methodology by adding: (1) quantitative methods for the evaluation of human risk assessment including exposure assessment for professionals and the general public; (2) quantitative assessment of the environmental effects by using a specific ballast water model, MAMPEC-BW 3.0.1.3 and (3) finalization of the second version of the database for 41 specific chemicals, including AS and neutralizer frequently used in BWMSs and disinfection by products (DBP) frequently observed, in which the physico-chemical data, the toxicological data and the environmental fate and effect data are included. For these 41 substances the applicants of BWMS do not have to submit the data mentioned anymore to IMO as the Group is of the opinion that all and sufficient, relevant information is already available. All physico-chemical data of 41 chemicals has already been included in the MAMPEC BW, version 3.0.1.3. The relevant data of these 41 chemicals are now also included in the GISIS database of IMO, where all Administrations and applicants can easily access this data.

4.2.11 In 2014, MEPC had started its work to review the Guidelines for approval of ballast water

management systems (G8) (resolution MEPC.174(58)), which is used for evaluating biological efficacy and granting type approval by National Administrations. This is the second amendment of Guidelines (G8), which may include the changes of test water conditions (salinity, DOC, POC and TSS), tank holding times (less than 5 days may be accepted) and evaluation of efficacy under extreme conditions. Although, the purpose of the review is to seek more accuracy on the evaluation of biological efficacy in ballast water treated by BWMS, the test water and treated water will be also used for evaluation in accordance with Procedure (G9). During its 71st meeting, MEPC agreed with the revision of Guidelines (G8) and also decided to make Guidelines (G8) mandatory and to transpose it into a Code.

4.2.12 Despite the controversy between the new Guidelines (G8) and the Methodology of WG34 on the approach of dangerous gases, the WG34 will continue to use its risk assessment approach and advice MEPC accordingly to its findings on the environmental and human health acceptability of the gases produced during the practical operation of the BWMS.

4.2.13 WG 34 held its 8th STW from 6 to 10 February 2017 at IMO Headquarters in London, which was mainly intended to review the proposed changes in Guidelines (G8) and the relation and consequences to the Methodology of WG34.

Planning ahead

4.2.14 The deadline for the submission of proposals for approval of BWMS to MEPC 72 is on 22 September 2017, which is relatively far in the future and therefore no applications were received to date. WG 34 scheduled two meetings to accommodate potential applications: BWWG 35 from 6 to 10 November 2017 and BWWG 36 from 11 to 15 December 2017, if needed. Of course, the number of meetings depends on the number of submissions. Both meetings are foreseen to be held at IMO Headquarters in London.

Acknowledgement

4.2.15 WG 34 is very thankful to all the members of GESAMP that took the time to critically review the work of WG 34. The quality of the work has been improved as a result from this peer-review process and the comments made were brought to the attention of the consultant involved in the drafting of the reports.

Methodology as a future GESAMP R&S Report

4.2.16 At the request of GESAMP, WG 34 had initiated the drafting of a R&S report (GESAMP 44/4/7). The Chairperson of WG 34 stressed that it was still a rather premature draft and would welcome comments and suggestions from the GESAMP members. In particular, he emphasized that the human health part and the environment part were still somewhat unbalanced. In this respect, the draft needed improvement and GESAMP suggested that the details of the human health assessment could be placed in an appendix as well as the MAMPEC model. It was further suggested that more details should be given on the model itself. Contact with the original developers of the model could be helpful.

4.2.17 GESAMP requested the report be made more readable for less informed readers by inclusion of some background and history on the involvement of GESAMP during the development of the Ballast Water Management Convention and its annexes, and especially the area of the evaluation of Active Substances in the introduction of the report.

4.2.18 It was agreed to produce a final draft manuscript for the publication in time for the next annual session of GESAMP in 2018, in order to have the report peer reviewed and printed before 50th anniversary of GESAMP in 2019.

Other issues

4.2.19 GESAMP was interested in the further evolution of BWMS after the entry into force of the Convention on 8 September 2017 in relation to the workload in the future. The Chairperson of WG 34 indicated that it was difficult to give a prognosis as a decrease of the number of submissions was expected already some years ago. The recent endorsement of the Guidelines (G8) as a Code could have a positive effect on the number of submissions received by IMO. On the other hand, the entry into force of the Convention could also reduce the number as less profit could be expected for applicants.

Action by GESAMP

4.2.20 Following discussion, GESAMP congratulated the WG 34 for its achievements, including the huge amount of time spent by the members of the WG. GESAMP stressed the need for the publication of the R&S report to inform scientific work in the area of risk assessment.

4.2.21 GESAMP decided to continue its function as peer reviewer of the WG 34 reports and the draft R&S report.

4.3 Atmospheric input of chemicals to the ocean (WG 38)

4.3.1 A report of the activities of Working Group 38 was presented by Mr Robert Duce, WG Co-Chairperson and GESAMP member. WG 38 was first established in 2008 due to growing concern about the impact of atmospheric deposition of both natural and anthropogenic substances on ocean chemistry, biology, and biogeochemistry as well as climate. The success of this WG in delivering high level assessment and peer-reviewed publications on the atmospheric input of chemicals to the ocean has contributed to the advancement of knowledge and increasing recognition of these impacts.

4.3.2 WG 38 has held meetings at the University of Arizona, Tucson, Arizona, United States, in 2008; at IMO in London in 2010; in Malta in 2011; and at the University of East Anglia, Norwich, United Kingdom in 2013 and 2017. Sponsors of those WG 38 efforts have included WMO, IMO, SCOR, SIDA, the European Commission Joint Research Centre, the University of Arizona, the International Environment Institute at the University of Malta, the University of East Anglia, and the US National Science Foundation. Following the initial terms of reference and the meetings through

2011, five scientific papers were published in the peer-reviewed scientific literature. These can be found on the GESAMP website.

4.3.3 During and following GESAMP 39, new terms of reference for the continued work of GESAMP WG 38 were approved to address issues related to the impact of the atmospheric deposition of anthropogenic nitrogen to the ocean. To address these new terms of reference, a workshop on “The Atmospheric Deposition of Nitrogen and its Impact on Marine Biogeochemistry” was held at the University of East Anglia in Norwich, United Kingdom, from 11 to 14 February 2013. As an outcome of the discussions on each task of the new Terms of Reference, seven scientific papers were planned.

4.3.4 Six scientific papers have been published and a seventh will be submitted for publication this fall. Following the completion of the publication of the papers resulting from the 2013 workshop on the impacts of atmospheric nitrogen deposition to the ocean, WG 38 has prepared a synthesis of the results from the scientific papers derived from that workshop as part of the GESAMP Reports and Studies series. That draft report was reviewed by GESAMP, and WG 38 will consider the comments received as they prepare a final report to be published by the end of 2017.

4.3.5 For the fourth year in a row, WG 38 organized a session on atmospheric input of chemicals to the ocean for the 2017 European Geosciences Union meeting, held in Vienna, Austria last April. The session was titled “Air-sea Exchanges: Impacts on Biogeochemistry and Climate”. A number of oral and poster papers were presented by a combination of WG 38 members and other scientists. The initial outcomes from the 2017 Norwich workshops (mentioned below) were also presented at this EGU session.

4.3.6 Mr Tim Jickells represented WG 38 at a number of key events in 2017. The first was a GAW workshop on Measurement-Model Fusion for Global Total Atmospheric Deposition (February 28 to March 2, 2017, Geneva) with a presentation (delivered remotely) on “Observation and Model based Estimates of Atmospheric Inputs to the Oceans”. The second was the GAW Symposium (10-13 April 2017, Geneva) with a presentation to the plenary session on the activities of GESAMP and then a presentation on “Observations and Modelling Needs to Understand the Impacts of Nitrogen Inputs to the Oceans at a side event on “How can GAW contribute to the N cycle assessment?”. The third event was the Third Informal Meeting of the International Law Commission (ILC) on the Protection of the Atmosphere as part of the Dialogue with Scientists (May 5, 2017, Geneva) with a presentation entitled “Linkages between the oceans and the atmosphere” and participation in the subsequent discussion.

4.3.7 At its 42nd session held at IOC in Paris, in September 2015, GESAMP approved two new activities for WG 38 to investigate the changing acid/base character of the global atmosphere and ocean and the impact of these changes on certain air/sea chemical exchange processes. The title of these activities are: “Changing Atmospheric Acidity and the Oceanic Solubility of Nutrients”; and “Impact of Ocean

Acidification on Fluxes of non-CO₂ Climate-Active Species”. Each have their own Terms of Reference. Two simultaneous workshops were held on these themes to initiate the work at the University of East Anglia (UEA) in Norwich, United Kingdom from February 27 through March 2, 2017. Funding was obtained for these workshops from the United States National Science Foundation (through SCOR), from WMO, and from IMO. The Surface Ocean Lower Atmosphere Study (SOLAS) also sponsored these workshops.

4.3.8 The focus of the work on “Changing Atmospheric Acidity and the Oceanic Solubility of Nutrients” is on how the changing atmospheric acidity will affect the solubility, and thus bioavailability of aerosol-derived nutrients such as iron and phosphorus when they are deposited in the ocean from the atmosphere. The focus of the work on the “Impact of Ocean Acidification on Fluxes of Atmospheric non-CO₂ Climate-Active Species” is on the impacts of ocean acidification on the oceanic sources of a range of non-CO₂ gaseous species, as well as aerosol precursors that are influential in regulating radiative forcing, atmospheric oxidizing capacity and atmospheric chemistry.

4.3.9 The workshops took the form of informal presentations from experts followed by lengthy discussion sessions exploring multiple issues and feedbacks evident in these complex air-sea interaction issues. The invited scientists were selected for their expertise and interest in these areas, and also to provide a wide spectrum of expertise from modellers to experimentalists. WG 38 drew 34 scientists from 15 countries and also from a wide range of career stages, from senior scientists through to graduate students. The participants all seemed to leave Norwich full of enthusiasm for the process and the new scientific insights the groups had developed. The aim now is to write a series of papers synthesising these conclusions. At present, roughly 12 papers are being developed from the workshop discussions.

4.3.10 A potential additional upcoming activity of WG 38 is an assessment of the impact of nitrogen on the marine environment as a contribution to the Integrated Nitrogen Management System (INMS). INMS is a global targeted research project with the aim to provide clear scientific evidence to inform future international nitrogen policy development. INMS's core funding will come from the Global Environment Facility (GEF) (the environment funding mechanism of the United Nations System) with the United Nations Environment Programme (UN Environment) as the Implementing Agency and the United Kingdom Natural Environment Research Council (Centre for Ecology and Hydrology) as the Executing Agency acting on behalf of the International Nitrogen Initiative (INI). INMS has had no involvement with groups with concerns about nitrogen in the marine environment. They are particularly concerned about certain regional areas, such as the Black Sea and the South China Sea. WG 38 has extensive experience in both regional and global ocean issues with regard to nitrogen. WG 38 has approached the INMS Secretariat with a proposal for collaboration.

Action by GESAMP

4.3.11 GESAMP noted the excellent progress made by WG 38, including the draft Reports and Studies publication which had been circulated for peer review amongst the GESAMP members.

4.3.12 GESAMP also noted that the group had not planned any additional meetings until the twelve papers, currently in preparation, had been finalized, and that any further additions to the current terms of reference for WG 38 would be a question for future GESAMP sessions.

4.4 Establishment of trends in global pollution in coastal environments (WG 39)

4.4.1 A report of Working Group 39 was given by the working group Chairperson, Ms Ana Carolina Ruiz Fernandez. She provided an overview of the history and work of WG 39, whose purpose is to contribute to the reduction of stress in coastal ecosystems by providing stakeholders, scientists and society with an objective and global assessment of pollution trends during the last century in sensitive coastal ecosystems. The task of WG 39 is to provide a retrospective analysis using dated environmental archives and time-series data from peer-reviewed published research. Contaminants assessed include both inorganic and organic pollutants, as well as miscellaneous pollutants such as nitrogen and phosphorus. Outputs are expected to include a bibliographic database, a methodology for the retrospective analysis, a global report including details on pollution trends in Large Marine Ecosystems (LMEs), a webpage, peer-reviewed papers and a final report.

4.4.2 Of the over 1,000 papers that were initially screened, 327 were included in the final database with data from 49 LMEs. Details were provided on the mathematical normalization of the data and the trend analysis by linear regression. A synthesis of global and LME data was presented for various contaminants and for time periods reflecting pre-heavy industry, rapid heavy industry development, and the modern era of industrial regulation. A timeline was presented for completing the activities of WG39. This included finalizing data analysis by December 2017, and finalizing the working group report by August 2018. This report will include a global summary as well as more detailed reports for 5-6 targeted Large Marine Ecosystems.

Actions by GESAMP

4.4.3 Having reviewed the report, GESAMP expressed appreciation and noted the value of the working group's activities, but expressed concern that completing the final report by August 2018 is too ambitious. The working group was instead requested to complete the final draft report by August 2018, for review first by GESAMP members, followed by external reviewers in the latter half of 2018. The working group should note in the final report that all of the data was collected from peer-reviewed published papers and that no direct monitoring was conducted. It should avoid including information implying the hazards associated with contaminant levels and focus instead on reporting on trends.

4.5 Sources, fate and effects of plastics and microplastics in the marine environment (WG 40)

4.5.1 A report of the activities of WG 40 was given by Mr Peter Kershaw, Co-Chairperson of the working group. GESAMP recalled that following discussion at GESAMP 43, the terms of reference (ToR) for the third phase of WG 40 were revised and accepted by ExCom at their intersessional meeting. There are three new terms of reference covering: i) methods of monitoring and assessment; ii) the impact of nanoplastics; and, iii) the potential for rafting of species by floating microplastics. It has been agreed that ToR 1 should be completed before pursuing ToRs 2 and 3. The remit of WG 40 has been expanded to include methods related to both macroplastic and microplastic litter. This is reflected in the new title of the working group.

4.5.2 The WG 40 objectives for 2017-2018 are to develop guidelines covering terminology and methodologies for the sampling and analysis of marine macroplastics and microplastics, more specifically: the size and shape definitions of particles; sampling protocols for the whole spectrum of particle/object sizes in surface and sub-surface seawater, seabed sediments, shorelines and biota; and, methodologies for physical and chemical identification and analysis of polymers and associated chemicals requirements for monitoring and assessment.

4.5.3 The membership of the working group has been refreshed to reflect the objectives of ToR 1 and the reduced overall level of funding available. To help meet the shortfall additional sources of funding have been sought and confirmed. Institutional support in addition to the lead agencies for WG 40 3rd Phase (ToR 1) now includes IMO (residual industry funding); NOAA, United States (Marine Debris Program); Ministry of Environment, Japan (G7 Marine Litter Action Plan); State Ocean Administration, China (G20 Marine Litter Action Plan); the North West Pacific Action Plan (NOWPAP) (G7 – Regional Seas collaboration); and the BASEMAN – JPI Oceans project (microplastics methods). The total membership is 15, with representatives from 14 countries in Africa, North and South America, Asia, Australasia and Europe. Two additional Co-Chairpersons have been appointed to cover the macroplastic (Alexander Turra, Brazil) and microplastic (Francois Galgani, France) methods and protocols.

4.5.4 The working group will hold the first workshop of the third phase immediately after GESAMP 44, in Paris, hosted by IOC-UNESCO (11 to 14 September). In the period leading up to the workshop, the members have been collating information about existing methods and protocols and populating the Basecamp website administered by IMO for use by GESAMP working groups. A draft for the technical report has been prepared and this will be refined during the Paris workshop. The group will also benefit from the report on microplastics in seafood, recently published as a Technical Report 615 by FAO, specifically on those sections dealing with biological and market sampling. Several members of the FAO working group are also current members of WG 40.

4.5.5 Initial discussions have been held with a number of regional organizations, including HELCOM,

OSPAR, SPREP, NOWPAP and UNEP-MAP, and this will be further extended and developed to ensure that the anticipated technical report will meet the needs of those organizations with responsibility for developing and implementing monitoring and assessment programmes. Further meetings of the working group are being planned during the 6th International Marine Debris Conference (6IMDC) to be held in San Diego, United States, in March 2018, with a second full workshop planned for June 2018.

4.5.6 GESAMP acknowledged the value, coordination and complementarity of FAO Technical Report 615 and welcomed the developments on microplastics in the context of food safety through the joint FAO and WHO Codex committee on contaminants which is in the process of identifying polymers for their toxicity. If Codex, through several formal steps, decides to proceed with a classification the issue will pass on to the JEFCA^a. GESAMP acknowledged that it would be important to the work also of WG40 to have the input for the health/food safety community through JEFCA.

4.5.7 GESAMP discussed the proposed new name of WG 40 (to: Sources, fate and effects of plastics and microplastics in the marine environment), reflecting the ToRs of the third phase. The aim of ToR 1 is to develop guidelines covering terminology and methodologies for the sampling and analysis of marine macroplastics and microplastics. This is intended to promote more harmonised monitoring and assessment programmes. In turn, this will encourage the exchange of comparable data, allowing its use in risk assessment and predictive models. GESAMP concluded that although the terms “microplastic” and “plastics” may not be scientifically well defined, they have become terms that are recognized and used by politicians, policymakers, media and the public, and that it would weaken the profile of the WG 40 to remove these terms from the name. The results of ToR 1 will be made available in a joint publication by GESAMP, IOC and UN Environment, with a target date of December 2018.

4.5.8 GESAMP discussed ToRs 2 and 3 briefly and concluded that these should be kept under review during the intersessional period and be discussed at GESAMP next session.

Action by GESAMP

4.5.9 GESAMP welcomed the continued progress made by the WG and noted the continued strong interest in and commitment to the WG by lead agencies IOC and UN Environment as well as that of additional supporting organizations. However, further funding will still be required to carry out the full, agreed work programme. The Chairperson of WG 40 undertook to further explore funding possibilities in cooperation with the sponsoring agencies.

4.6 Marine geoengineering (WG 41)

4.6.1 A report of the activities of the working group on marine geoengineering (WG 41) was given by Mr Chris Vivian, Co-Chairperson of the working group.

^a Joint FAO/WHO Expert Committee on Food Additives

4.6.2 GESAMP noted since the last session, the main activity of WG 41 had been the second meeting which took place from 26 to 28 April 2017, at the WMO Headquarters, Geneva, Switzerland.

4.6.3 Since the report at GESAMP 43 (document 43/4/5), the WG members each completed the scoring sheet that had been developed earlier. The scoring sheet covered 29 marine geoengineering techniques with 17 criteria to be scored against the techniques. The scores were then collated and summarized by Philip Boyd and presented at the second meeting.

4.6.4 The scoring of each approach in the assessment had been difficult, and in almost all cases was hindered by a lack of information in the permanent record. However, it was deemed a worthwhile investment and was built upon at the meeting. Debate took place on the rationale for selecting geoengineering approaches to be considered in more detail. Due to the widespread gaps in knowledge about geoengineering approaches, the selection of a subset of approaches to be further scrutinised could not be based on an authoritative view.

4.6.5 It was noted that the WG, following extensive discussion, had decided to select an illustrative approach across each of eight distinct geoengineering categories. The approaches selected were: ocean iron fertilisation; CO₂ storage on the seabed; foams to increase ocean albedo; direct addition of alkaline material; marine cloud brightening; artificial upwelling; macroalgal cultivation; fertilisation for fish stock enhancement.

4.6.6 Due to the paucity of information available on some evaluation criteria, the WG reduced the number of criteria from 15 to 8. Five of the criteria are essentially the same as the ones employed in the UN CBD revised 2015 report, including three others – in particular knowledge base (a major impasse in the view of WG 41), along with detection and attribution, and geographical and temporal scales. This selection of illustrative approaches and evaluation criteria provided an 8 by 8 table to be populated by the WG. Critically, the selection of ocean iron fertilisation (for which there is an existing regulatory framework, the LP/LC) as part of the detailed assessment, enabled other categories of geoengineering approaches to be compared and contrasted with it. Such intercomparisons will help inform the IMO and LP/LC on the diversity of regulations needed to encompass a broader range of geoengineering approaches.

4.6.7 In order to make the WG assessment more relevant for policymakers, the appraisal process must become more multi-faceted and inclusive of other disciplines. The WG expressed the need to broaden the disciplinary composition of the WG towards more social scientists, and advocated that funding routes are sought for a third year of the WG.

4.6.8 The need to extend the WG for a further year was also evident from a discussion around how to obtain sufficient information in the permanent record to produce an authoritative scientific assessment on marine geoengineering approaches. The debate centred on the need to develop a simpler “pre-assessment” knowledge gathering process that would

receive direct scientific feedback, as an incentive to obtaining enough information from proponents of geoengineering approaches to produce a robust assessment.

4.6.9 GESAMP noted that the WG is close to making some significant advances on incentives to provide more baseline knowledge needed to provide a robust scientific assessment. The development of such a knowledge platform is essential to both inform other appraisals (based on legal, socio-political, economic and geopolitical characteristics), and to better frame the concurrent development of research governance (i.e. what are the facets of geoengineering research need to be considered in governance?).

4.6.10 At present, a revised version of the 8 x 8 synthesis table is being edited. The Co-Chairpersons have also circulated a full report from the April 2017 meeting along with an executive summary for feedback. A full draft report of the year two progress by the WG is also being edited after a round of WG comments and feedback.

4.6.11 At present no further WG 41 meeting is scheduled for 2018. The full report is expected to be finalized in the first quarter of 2018, following by a peer review, which would be needed prior to publication.

Action by GESAMP

4.6.12 GESAMP noted progress made, and the timeline for finalization of the report. It was also highlighted that the ‘Oceans Day’ at UNFCCC COP23, to be held in Bonn, Germany from 6 to 17 November 2017 which presents the opportunity to raise awareness about the WG and its work.

4.7 Impacts of wastes and other matter in the marine environment from mining operations, including marine mineral mining (WG 42)

4.7.1 A report of the activities of the working group on impacts of wastes and other matter in the marine environment from mining operations, including deep-sea mining (WG 42) was given by Ms Tracy Shimmield, Chairperson of the working group.

4.7.2 GESAMP noted that since the last session, progress had been made with initiating the work of the WG. A first meeting between the Chairperson of GESAMP, the IMO Technical Secretary for GESAMP and Chairperson of WG 42 took place at IMO in London, in February 2017. At the initial meeting, the Terms of Reference (TORs) for WG 42 were reviewed and prospective members of the working group identified. During March 2017, the ToRs were revised and approved. In 2016, GESAMP agreed that WG 42 would undertake the first term of reference, (see document GESAMP 42/7/1).

4.7.3 Throughout April 2017, prospective group members were contacted and invited to participate in the group and were sent a copy of the ToR. The current working group membership includes nine members from seven countries with expertise spanning benthic ecology, geochemistry, physical oceanography, sediment modelling and fisheries.

4.7.4 The first meeting of the group took place by teleconference on 18 May 2017 with the majority of members taking part. The main purpose of the meeting was to discuss and agree next steps, report structure, timetable and set the dates for the first workshop of the group. The group also discussed and agreed a number of details to do with the report structure and the use of Basecamp for document sharing. Basecamp was set up for all members of the group in May 2017. An initial report format and task list was circulated to the group in June 2017.

4.7.5 GESAMP noted that the first formal meeting and main workshop of WG 42 was scheduled to take place from 20 to 22 September 2017, hosted by IMO. At this meeting, the group would discuss and finalize the report structure, actions and dates for draft and final report delivery.

4.7.6 GESAMP discussed the relationship of GESAMP with the International Seabed Authority (ISA) with relation to deep sea mining and WG 42. It was noted that it would be an advantage to have the ISA as a formal co-sponsor of the working group as this would encourage a flow of information from ISA to WG 42 and vice versa. In addition, engagement would also give the opportunity to discuss/identify transboundary issues related to deep-sea mining from territorial waters to high seas and cumulative effects from more than one mining site in an area.

Action by GESAMP

4.7.7 GESAMP noted that the ToR needs further refining to ensure clarity on how the working group would identify and provide a better understanding of both potential environmental impacts of mine tailings discharge into the marine environment and sea bed mining, recognizing there will be a difference in potential impacts of mine tailings from land based mining and sea bed mining.

4.7.8 GESAMP agreed on the following revised first term of reference:

“Identify and provide a better understanding of potential environmental impacts of marine disposal of associated wastes from land-based mining (hereinafter referred to as “mine tailings”) and potential environmental impacts from sea-based mining operations. This should take account of interactions of mine tailings and other matter associated with mining operations in both nearshore and deeper water ecosystems with resources in the water column (e.g. ecological, biological) excluding sand and gravel mining. The impacts could include, but are not limited to, those identified in the report of the workshop on mine tailings provided to GESAMP at its last meeting (see document GESAMP 42/7/1).”

4.7.9 It was also noted that ISA had made available a document entitled “Draft regulations on exploitation of mineral resources in the Area” (ISBA/23/LTC/CRP.3) for comments by stakeholders, together with a list of questions contained in document ISBA/23/C/12, and that there may be an opportunity for GESAMP to comment on the draft regulations.

5 CONTRIBUTION TO OTHER UN PROCESSES

The UN Regular Process

5.1 Following the completion of the first cycle of the UN Regular Process and the publication of the First World Ocean Assessment (WOA I) in January 2016 (see http://www.un.org/Depts/los/global_reporting/WOA_RegProcess.htm), the second cycle of the Process was initiated. To facilitate the second cycle, the Division for Ocean Affairs and the Law of the Sea (DOALOS), as the secretariat for the Regular Process, has provided an extensive abstract of lessons learned from the first cycle, available at: http://www.un.org/Depts/los/global_reporting/7th_adhoc_2016/Abstract_on_Lessons_Learned_rev26072016.pdf

5.2 The abstract summarizes feedback received with respect to the duration of the assessment cycle, the policy relevance of the results, scope, data sources, the support structure and set-up, methodology of work, outreach and awareness-raising, the review process, cooperation with other bodies, resources and capacity building.

5.3 The seventh meeting of the Ad Hoc Working Group of the Whole was held from 3 to 9 August 2016, and a preliminary work programme for the second cycle, from 2017 to 2020 was agreed by the Group. The full report of the meeting, including the work programme, can be found at: <http://undocs.org/A/71/362>

5.4 More recently, the eighth meeting of the Ad Hoc Working Group of the Whole was held from 17 to 18 April 2017. The meeting considered, inter alia, terms of reference and working methods of the Group of Experts for the second cycle of the Regular Process, the mechanism for the establishment of the Pool of Experts for the second cycle of the Regular Process, and terms of reference for National Focal Points. The report of the meeting will be posted on the DOALOS website in due course.

5.5 The 2016 UNGA resolution Invited UN bodies to assist in the implementation of the second cycle of the Regular Process with regard to the following activities: awareness-raising, the identification of experts for the Pool of Experts, technical and scientific support to the Bureau and the Group of Experts, hosting workshops and meetings of the writing teams, capacity-building and the scoping process for the assessment(s) of the second cycle.

Action by GESAMP

5.6 GESAMP reconfirmed its willingness to contribute to the second cycle, WOA II, and decided to follow developments closely with a view to identify possibilities for contributing, at the request of the Sponsoring Organizations.

The 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs)

5.7 In September 2015, 193 UN Member States unanimously adopted the 2030 Agenda for Sustainable

Development, which includes 17 SDGs and 169 targets (A/RES/70/1). The full 2030 Agenda for Sustainable Development resolution and additional related information can be accessed at: <https://sustainabledevelopment.un.org/post2015/transformingourworld>

5.8 Subsequently, the General Assembly adopted resolution 70/226, accepting the offer from the Governments of Fiji and Sweden to co-host the UN Conference to support the implementation of SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. The Conference was held in New York, from 5 to 9 June 2017.

Action by GESAMP

5.9 GESAMP was invited to consider the outcomes of the Conference and ways it can contribute to the implementation of the 2030 Agenda.

Other projects and initiatives

5.10 The IOC-UNESCO Technical Secretary for GESAMP presented the IOC initiative for the development of an International decade on ocean science for sustainable development (2021-2030) – Towards the ocean we need for the future we want – under the auspices of the United Nations (<http://en.unesco.org/ocean-decade>).

5.11 The proposal to launch the Decade was adopted by the IOC Assembly in June 2017 and the Decade proposal will be transmitted to the UN General Assembly (UNGA) in September 2017 for its consideration with a view to establish the Decade under the auspices of the United Nations. As is generally the practice with international decades, the UNGA would then set up a process for preparing the activities to be implemented during the Decade. This would take the form of a concerted programme of action that would include, amongst other things, organizational arrangements for coordinating the implementation and reporting on the Decade achievements. Prior to its formal consideration by the UNGA, the Decade proposal must include a draft programme of action with clearly defined objectives and activities to be carried out at the international, regional and national levels.

5.12 Tentative timeline:

- August 2017: Transmission of IOC Resolution outcome to the informal consultations for the UNGA Omnibus Ocean Resolution
- November 2017: Endorsement by the UNESCO General Conference of the proposal for an international Decade
- November 2017: Adoption of UNGA Ocean Omnibus Resolution setting up the process for developing the draft programme of Action of the Decade in consultation with Member States, and relevant UN bodies
- January 2018-July 2019: Preparation of Programme of Action through consultations

with Member States, UN partners and other stakeholders

- September 2019-January 2020: Formal consideration of the Decade programme of action and decision by UNGA

Action by GESAMP

5.13 GESAMP welcomed the initiative for the Decade and decided to express its intent to partner in the development and implementation of the Decade.

6. IDENTIFICATION OF NEW AND EMERGING ISSUES

6.1 This GESAMP agenda item is intended to provide an opportunity for members to bring new topics related to the status of the marine environment to the attention of the Sponsoring Organizations, and to discuss issues arising during the course of the current GESAMP meeting. One topic was identified and discussed during this session.

Deep-sea mining

6.2 During the informal meeting of the GESAMP members on the morning of 4 September 2017, the issue of deep-sea mining and its potential impacts on the marine environment was discussed.

6.3 The members discussed the relationship of GESAMP with the ISA, in relation to deep-sea mining and WG 42. The members were of the view that it would be an advantage to have the ISA as a sponsoring agency for WG 42 (see agenda item 4). This would encourage the flow of information from ISA to WG 42 and vice versa. In addition, this engagement would also give the opportunity to discuss/identify transboundary issues related to deep-sea mining from territorial waters to high seas and cumulative effects from more than one mining site in an area.

Action by GESAMP

6.4 GESAMP noted that the issue of the environmental effects of deep-sea mining was part of the terms of reference for WG 42 and that any related issues emanating from the work of the group would be discussed at future sessions.

7. SCOPING ACTIVITIES

7.1 At its last session, GESAMP considered proposals for new and emerging issues, which were developed intersessionally into scoping papers. The following scoping papers were presented and discussed.

7.2 UNDP, through the GESAMP members, noted frequently cited figure of 80% of ocean pollution is land-based (often quoted in various media, publications, and other materials), the other 20% being from ships and marine infrastructure. It is believed that this figure is derived from a study, probably by UN Environment, from some time in the 80's. Since that time, the ocean pollution landscape has changed dramatically. Disposal

of solid waste and sewage by ships at sea, which was once routine, has almost certainly declined significantly with increased regulation and enforcement. Large ship oil spills have declined about four-fold while shipping volume has tripled, equivalent to about a 93% reduction in their frequency. In parallel, fairly solid estimates for major land-based sources of pollution, particularly for nutrients and plastics, but probably also oil run-off, have entered the literature. Therefore, it was suggested that it could be timely to revisit and update the 80% figure by filling the key gaps in arriving at these figures.

7.3 In the discussion that followed, it was noted that the estimate also appeared in GESAMP Reports & Studies No.39 (1990), and it was therefore suggested that GESAMP considers establishing a task team to update this figure. It was also noted that that regional variations will have to be taken into account and that the figure is considered as a global average.

Action by GESAMP

7.4 Following the discussion, GESAMP agreed to establish a correspondence group to prepare a scoping paper during the intersessional period on possible options for updating the overview of main sources of pollution in the marine environment. The paper will be presented and discussed at the next annual session of GESAMP.

Impacts of residues of chronic oil spills

7.5 Ms Felicia Chinwe Mogo introduced document GESAMP 44/7/1, which had been prepared in collaboration with Ms Anna Carolina Ruiz. The presentation highlighted how frequent oil spill incidents, coupled with continuous application of dispersants, are leaving a build-up of a variety of chemicals that are eventually deposited at different levels in the water columns, and their toxic impacts on biodiversity and sediments. These harmful chemicals could be transferred through the food chain/foodweb into humans and pose subsequent environmental issues. It was therefore suggested that further information on the issue would be beneficial, in order to fill the knowledge gaps.

7.6 In the discussion that followed, GESAMP discussed the regional nature of chronic spills, as well as the issue of chronic versus acute spills.

Action by GESAMP

7.7 Following discussion, GESAMP agreed to proceed with a revised scoping paper, with the involvement of other GESAMP members with expertise on the issue. The revised scoping paper should take into account other studies, including earlier GESAMP reports, covering the subject matter.

Relevance of inputs of disinfection byproducts (DBPs) into the marine environment

7.8 Mr Thomas Höfer and Mr Matthias Grote presented document GESAMP 44/7 on the relevance of ballast water related disinfection byproducts (DBPs) production against other input of DPBs into the aquatic environment.

7.9 GESAMP noted that there were several challenges with estimating the contribution of the various sources to a global overview of DBPs, including the impact of multiple stressors, as well as regional and local variations. It was suggested that the work of the HFC/CLC community would be of relevance, such as the Advanced Global Atmospheric Gases Experiment (AGAGE), that measures CFC and HFCs in the atmosphere. The Chairperson of WG 34 noted that earlier work by GESAMP on the subject should also be taken into consideration.

7.10 GESAMP also noted with great appreciation the offer from the German Federal Institute for Risk Assessment to convene a workshop on the matter in 2018. GESAMP also agreed that a more appropriate title for the activity would be "Relevance of inputs of disinfection byproducts (DBPs) into the marine environment".

Action by GESAMP

7.11 Following discussion, GESAMP agreed to convene a workshop, in cooperation with the German Federal Institute for Risk Assessment, preferably prior to GESAMP 45 in 2018. An updated scoping paper would be prepared prior to the workshop, taking into account the comments made by GESAMP as well as previous efforts on the issue.

Causes and impacts of massive accumulations of the brown macro-algae Sargassum in the nearshore environment of the Caribbean and West Africa

7.12 The GESAMP Chairperson presented document GESAMP 44/7/2 on the causes and impacts of massive accumulations of the brown macro-algae Sargassum in the nearshore environment of the Caribbean and West Africa. GESAMP noted that the scoping paper provided an excellent overview of the current status of the issue. Several Sponsoring Organizations expressed an interest, and were currently involved in addressing the matter.

7.13 It was noted that the occurrences were not restricted to the Caribbean and West Africa regions, but also observed in several areas in Asia. GESAMP also noted that some of the Sponsoring Organizations (such as FAO, UN Environment and UNESCO-IOC), and other bodies, were already addressing the issue, and that GESAMP's possible role would need careful consideration. Several Sponsoring Organizations expressed an interest in finding a solution to the Sargassum accumulations, and that coordination of the various activities currently ongoing in various fora would be beneficial. GESAMP could therefore, potentially, be able to provide assistance with such coordination.

Action by GESAMP

7.14 GESAMP decided to discuss further with the Sponsoring Organizations involved in the issue, with a view to identifying and defining a possible role for GESAMP, and how this can contribute to the ongoing efforts of the Sponsoring Organizations.

Impact of pharmaceuticals and other novel chemicals on wastewater

7.15 GESAMP considered a scoping paper on the impact of pharmaceuticals and other novel chemicals on wastewater (GESAMP 44/7/4), which was presented by Ms Felicia Mogo. It was noted that adverse effects of these pharmaceuticals have been recorded in the marine environment, due to the presence of anthropogenic pharmaceuticals in the marine environment, and that the pharmaceuticals, particular when occurring in various combinations, can cause effects through bioaccumulation in the marine environment and aquatic ecosystem. It was also noted that there is a paucity of data and research concerning concentration and impact on human and other organisms on the higher trophic level of the food chain/web, and in some regions of the world such as Small Island states, Africa amongst others.

7.16 GESAMP noted that the current scope as currently presented was too broad for involvement by GESAMP, and that a more narrow focus would be of interest to some of the Sponsoring Organizations. It was proposed that a clearer focus on the marine environment, and environmentally persistent pharmaceuticals, would be beneficial. It was further noted that it was essential to specify the chemicals of concern, and do an extended literature review, including studies available on estuarine and coastal environments.

Action by GESAMP

7.17 GESAMP agreed to revise the scoping paper in the intersessional period, with the revised, more clearly defined focus on the marine environment. It was also agreed to pursue the possibility of convening a workshop under the lead of UN Environment, based on the revised scoping paper.

Sand and gravel mining

7.18 Mr Emmanuel Ajao, presented the document GESAMP 44/7/3, on sand and gravel mining: new insights on an emerging environmental problem. GESAMP noted that the paper identified an issue of great importance, but there was scope for improving the overview by taking into account latest knowledge found in adjacent industries and subject matters (such as within the dredging community). It was also noted that the scope needed to be revised to provide a more clear focus on the marine environment.

7.19 The Sponsoring Organizations indicated a general interest in the issue, but that a revised scoping paper was needed in order to decide on the best way forward, and the potential role for GESAMP. The World Maritime University's contribution and interest in the subject was also acknowledged.

Action by GESAMP

7.20 GESAMP agreed to proceed with the revision of the scoping paper in the intersessional period, with an expanded membership. GESAMP also agreed to change the title of the scoping paper to "Sand and gravel mining: updating the information on sources and levels of the main pollutants impacting the global

marine environment".

8 GESAMP SIDE EVENT

GESAMP Side event: Carbon dioxide in the atmosphere-ocean system: impacts and feedbacks

8.1 In the afternoon of Wednesday 6 September, WMO and GESAMP held a special side event titled "*CO₂ in the Atmosphere-Ocean System: Impacts and Feedbacks*". The side event was introduced by Ms Silvina Carou, Technical Secretary for WMO, and was open to others outside of GESAMP 44. The moderator was Mr Robert Duce, GESAMP member and Co-Chairperson of WG 38. The invited speakers were Ms Tatiana Ilyina from the Max Planck Institute for Meteorology, Ms Carol Turley from the Plymouth Marine Laboratory (PML), and Ms Frances Hopkins also from PML. There were approximately 40 people in attendance.

8.2 Globally averaged atmospheric concentrations of the major long-lived greenhouse gases (carbon dioxide, methane and nitrous oxide) have risen considerably since pre-industrial times due to emissions related to human activity. These gases collectively account for ~88% of the radiative forcing by long-lived GHGs.^b Their concentrations, also regulated by natural sources and sinks, form part of natural biogeochemical cycles. CO₂ is the single most important GHG, as it is responsible for 65% of the radiative forcing by LLGHGs and for 81% of the increase in radiative forcing over the past decade. Globally averaged atmospheric CO₂ has increased by ~40% since pre-industrial times (before 1750). The largest CO₂ sinks are the land biosphere and the oceans, with the latter absorbing ~26% of the emitted anthropogenic CO₂.^c

8.3 A direct consequence of the excess CO₂ absorbed by the oceans is ocean acidification. Since the beginning of the industrial revolution, the ocean has become ~27% more acidic and ocean acidity could increase by 150% by 2050. Ocean acidification affects many organisms, especially calcifying organisms, such as corals, and is a serious global threat to the ocean food web, ecosystems and resources. Other impacts on the oceans related to increases in atmospheric GHGs include warming and deoxygenation, as >90% of the heat energy accumulated in the climate system is stored in the ocean. Although the surface ocean is changing the fastest, the uptake of CO₂ and heat from the atmosphere is also rapidly changing the pH, temperature and oxygenation of the deep oceans.^d In addition to acting as a sink, the ocean contributes to many aspects of the Earth's climate system, including its atmospheric composition, surface temperature and the hydrological cycle. There is a potential that the ocean sink might become saturated and reduce the

^b WMO Greenhouse Gas Bulletin No. 12, October 2016

^c IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

^d The Ocean Conference, June 2017. Concept Paper on Partnership dialogue 3: Minimizing and addressing ocean acidification

uptake of the anthropogenic emissions, increasing the fraction of emitted CO₂ and other GHGs thus accelerating their atmospheric growth rate. Understanding and quantifying the magnitude and impacts of this feedback are of urgent interest.

8.4 The side event was intended to provide an overview of existing scientific knowledge on this topic and to discuss how this ties in with GESAMP's existing and/or future work.

Ocean carbon cycle feedbacks and global change
(Ms Tatiana Ilyina, Max Planck Institute for Meteorology, Hamburg)

8.5 Atmospheric CO₂ concentrations and anthropogenic CO₂ emissions continue to grow. The Global Carbon Budget (GCB) aims to quantify these changes, however, there are a number of processes that contribute to uncertainties in the GCB in terms of sources and sinks. Atmospheric concentrations are increasing due to rising emissions and it is crucial to quantify the ocean and land carbon sinks. The Southern Ocean accounts for about 50% of the ocean carbon sink. Not many observational products on the air-sea CO₂ fluxes are available, especially for the Southern Ocean. Novel observational products show a pronounced increase in the annual and decadal ocean sink, but also show strong decadal variability. This increase is captured in Earth System Models (ESMs), but capturing decadal variability remains challenging making it difficult to provide clear information to policymakers. GCB takes into consideration the framework by DeVries et al. 2017 that there is a relationship between ocean circulation and the ocean carbon sink, where changes in the upper-ocean overturning circulation have affected the oceanic CO₂ sink. GCB is also dealing with the "unaccounted carbon" which is non attributable and is missing in processes in models.

8.6 Decadal variations in the carbon sink is the focus of the World Climate Research Programme's Grand Challenge (GC) on Carbon Feedbacks in the Climate System, co-chaired by Ms Ilyina. The GC tries to understand how biogeochemical cycles and feedbacks control CO₂ concentrations and impact the climate system. There are huge uncertainties in quantifying this. The IPCC AR5 reported that based on ESMs, there is a high confidence that the feedback between climate and the carbon cycle (CO₂ concentrations → global mean surface temperature) is positive in the 21st century. This relationship is an important message for policy, however, the spread of uncertainty is quite large. ESMs produce a spread of >300ppm uncertainty in carbon cycle projections which is comparable to differences across socio-economic scenarios. There is also great uncertainty in carbon feedbacks (CO₂ emissions → concentrations) and climate feedbacks (CO₂ concentrations → climate response).

8.7 The GC has three guiding questions and four research initiatives for addressing the questions (<http://www.wcrp-climate.org/gc-carbon-feedbacks>). Following a number of workshops they will soon be able to provide concrete outcomes. The presentation focused on two of the guiding questions:

8.8 *What are the drivers of land and ocean carbon sinks?* There is better knowledge of ocean drivers than land drivers. For the ocean, key mechanisms have been identified but with large uncertainties regarding their strength, regional and multi-year variability. There is a large uncertainty spread in observational and modelled estimates of the ocean carbon sink. There is also an unclear relative contribution of physical vs biological processes. The Southern Ocean is responsible for about half of the ocean carbon sink and dominates its variability. ESMs do not capture this variability. It is now becoming possible to study this variability with large ESM-based ensembles. For instance, one third of MPI-ESM ensemble members captures decreasing decadal ocean sink trends in the Southern Ocean as indicated by observations. In the near future, the same number of ensemble members will predict decadal decreasing trends in the ocean carbon sink. This means that it will not be easy to attribute the response of the system to mitigation efforts.

8.9 *What is the potential for amplification of climate change over the 21st century via climate-carbon cycle feedbacks?* In terms of the ocean, the GC is looking at how changes in climate, ocean circulation, and biogeochemical mechanisms will affect the ocean's capacity to sequester carbon. A study shows that ESMs with overestimated seasonal carbon uptake project larger future carbon uptake in the Southern Ocean. Another question is: *Are decadal variations in ocean carbon uptake predictable?* Ocean (and land) carbon cycle components are included in the ESM-based prediction systems. Prediction skill for physical parameters like sea surface temperature is quite robust. Can we do the same for the carbon sinks? Carbon uptake in the north Atlantic is quite predictable and maintained over the winter. There is promise in the system indicating a robust prediction skill for the global ocean carbon uptake. By improving prediction of physical parameters you improve overall prediction capacity for the carbon cycle.

8.10 In summary, there is an urgent need to have better understanding of key biogeochemical processes and their feedbacks on the climate system. There is a strong decadal variability in the ocean carbon uptake indicated in observations and diagnosed in modelling studies. The Southern Ocean has a prominent role in driving decadal variations and carbon climate feedbacks (as well as their changes). ESMs are becoming 'standard' tools for the climate community to address decadal variability, predictability, and carbon climate feedbacks. ESMs have challenges due to missing or unresolved processes (e.g. mesoscale eddies, overturning, marine biology, nutrients, etc.). New observational techniques (e.g. argo floats, gliders, satellite data, improved paleo reconstructions) promise advances in filling knowledge gaps.

8.11 Following questions from the audience, Ms Ilyina added that the last glacial cycle is a perfect study case for improving ESMs. ESMs are computationally heavy to run but it is becoming feasible to run them over the glacial cycles. There are also very good observations from the last glacial cycle. In addition, with high resolution models (e.g. 0.1 degree) we will be able to have a better understanding of the role of mesoscale processes in the ocean in today's

and future climate. The computational cost is high so it is not possible to run simulations over long periods. Also, the ocean is quite slow (more than 1000 of spin up time is required) so this is a challenge to set up high resolution ESM simulations.

Ocean acidification and other CO₂ related stressors
(Ms Carol Turley, Plymouth Marine Laboratory, United Kingdom)

8.12 The ocean absorbs over a quarter (27%) of manmade CO₂ emissions. Ocean acidification is happening now and is measurable. As CO₂ concentrations increase, ocean pH decreases resulting from the formation of carbonic acid. The ocean will never become acid. It is a process and there is natural variation in the ocean with this variation moving downward in the pH scale towards acidity. It is difficult to explain to the public that a change of 0.3 in surface seawater pH means a doubling of hydrogen ion concentration. Ocean acidification is not just a pH change but also a change in hydrogen and carbonate ions. Carbonate chemistry is complex but is well known. We know that different organisms respond differently to these changes. Ocean acidification affects the carbonate saturation state which may cause calcium carbonate to dissolve if it is unprotected. The effects are greatest in cold water (e.g. in polar seas and near the sea floor). Aragonite is an important material in coral reefs and marine shells/skeletons. Cold waters are projected to soon become corrosive to aragonite. Just like temperature, pH changes seasonally, diurnally, and geographically so there is a lot of spatial and temporal variability.

8.13 There are different implications for organisms depending on short term exposure versus long term exposure to pH and temperature variations. Some effects are direct (from CO₂ and pH) while other indirect and complex effects on ecosystems and ecosystem services may have environmental and societal consequences. Hundreds of experiments have been conducted around the world over the last 10 years on the direct biological effects of high CO₂ and low pH. Some experiments are in situ at the ecosystem level and some on individual species, generally showing a consistent response (both positive and negative) to a change of 0.4 pH. The question is are the effects on biology already happening? Other studies are finding that reversal of ocean acidification to pre-industrial levels enhances net coral reef calcification. Also, CO₂ seeps from the sediments in the Mediterranean sea and elsewhere give us a glimpse into a high CO₂ world. The closer you get to CO₂ vent sites the lower the biodiversity, with calcifiers disappearing and anemones and algae becoming more abundant. Cold water corals may be particularly vulnerable. Their "reef" structure is composed of the dead skeletons of their ancestors on which living coral grows and are a biodiversity hotspot. As aragonite saturation changes it is highly unlikely these coral reefs will survive. Scientists have also found a great variability in impacts from ocean acidification depending on the organism's lifecycle – embryos and juvenile forms being generally more sensitive than adults. A lot of an organism's energy is spent maintaining internal pH so ocean acidification challenges the energy an organism gives to different physiological processes. Pteropods shells (made of aragonite) are already dissolving in the Southern Ocean

and off the coast of California with potential impacts on the food web.

8.14 One very good example of the economics of ocean acidification is available for the Pacific NW oyster hatcheries which started to decline in 2005 with 80% mortality by 2008 attributed to upwelling of low pH waters. Temporary mitigation measures were put in place that consisted of a US \$500K monitoring system, which itself shows the adaptability of the human species to ocean acidification. A cooking experiment of shrimp grown at high CO₂ demonstrated a difference in the taste. The ocean is also absorbing 93% of the heat from global warming and all of the water from melting ice, and ocean oxygen concentrations are decreasing. A paper by Gattuso et al. (Science 2015) combined all stresses (warming, acidification, oxygen loss and sea level rise) and showed that based on the business-as-usual RCP8.5 emission scenario, the risk to many ecosystems and their services will be very high. A table showing climate scenarios and the simulated change in air surface temperature, sea surface temperature and surface ocean pH relative to preindustrial time shows that the current goal of the Paris Agreement and Nationally Determined Contributions (NDCs) would reduce the risk but not sufficiently for some ecosystems. For example, the risk would still be high such as for finfish and tropical coral reefs. The highest societal risk will be to coastal communities who in many cases are least able to adapt.

8.15 In conclusion, there is a need for wider monitoring of ocean acidification (chemical changes and biological effects) and for consideration of solutions on how to mitigate impacts. Current NDCs are not enough to avoid high risk to some ocean ecosystems and the goods and services they provide. We urgently need more ambitious CO₂ emission reductions.

8.16 Following questions from the audience, Ms Turley added that there is a lag time of about 30 years between what comes out and what goes into the ocean. Much of this will be buffered over 10,000s of years and so pH will continue to decrease this century. The degree to which it changes will depend on atmospheric concentrations so reducing CO₂ emissions is essential. However, we also need to look at adaption to a changing ocean. Events like coral bleaching are already happening more rapidly compounded by other stressors to the marine ecosystem. Very little funding is dedicated to solutions and adaption at the moment but there needs to be more emphasis on how societies will adapt. This includes geoengineering solutions to climate change and the need for good scientific assessment of the pros and cons of proposed methods, including their impact on the ocean. Current experiments on ocean acidification are now far more sophisticated than just placing an organism in low pH conditions and observing what happens but it is still very challenging to project what future marine ecosystems may look like and be able to provide us. It is the rate of change that is important as it is happening at a rate faster than seen for millions of years so many organisms may not be able to evolve or adapt in that time. Societies, especially those dependent on shoreline protection, food and other resources from the sea, around the world need to prepare for substantial changes to marine ecosystems from the combined impact of ocean

warming, deoxygenation, acidification and sea level rise and the goods and services they provide.

Changing ocean acidity as a modulator of atmospheric biogeochemistry and climate
(Ms Frances Hopkins, Plymouth Marine Laboratory; GESAMP WG 38)

8.17 The surface ocean is a large source of a cocktail of gases that rapidly react to form other compounds. These include halocarbons, nitrogen-containing gases, volatile organic compounds (VOCs), dimethyl sulfide (DMS) and climate-active species (CO_2 , N_2O , CH_4). These gases react to form ozone and aerosols and/or contribute to radiative forcing. The source of these gases is mostly biological (phytoplankton and seaweed). There are a range of methods to look at the effects of ocean acidification on these gases each with their strengths and limitations. One type are mesocosm experiments which tell us about the whole community response during bloom conditions, short/medium-term acclimation and adaption, and longer term evolutionary adaptation to ocean acidification. These experiments have limitations in terms of logistics, costs, minimal geographic coverage, etc. Shipboard incubation experiments are an alternative to mesocosm experiments as they provide more extensive spatial coverage. They tell us about the eco-physiological response of microbial communities, acclimation from short-term CO_2 exposure, and the extent of variability in adaptive capacity between communities. Single species culture experiments (single species grown in the laboratory) are short term studies that tell us about the acclimated response to ocean acidification, isolate direct response on trace gas production, and eliminate extracellular bacterial processes.

8.18 DMS emissions make up 80 to 90% of marine biogenic emissions and ~50% of global biogenic emissions. DMS reacts rapidly in the atmosphere to produce aerosols which have a global albedo and climate effect. DMS also mixes with NH_3 and VOCs. Mesocosm experiments on the effects of ocean acidification on DMS have been performed in few coastal areas but not in the open ocean. A mesocosm experiment performed in the Arctic (Svalbard, 2010) reported concentrations of DMS and its algal precursor DMSP (dimethylsulphoniopropionate), and showed an increase in DMSP as an effect of CO_2 and a decrease in DMS under high CO_2 conditions during a nutrient-induced phytoplankton bloom. These responses demonstrate direct effects of CO_2 on phytoplankton and bacterial performance and indirect effects of CO_2 on competition and interaction. A consistent response to ocean acidification was seen in other mesocosm experiments. Some of these data have been used in Earth System models, showing that the changes to DMS seen in mesocosms under future CO_2 levels are sufficient to influence climate globally – a decrease in DMS flux results in a warming effect on global climate due to a reduction in the formation of natural atmospheric aerosols. One way to increase data is by looking at shipboard incubations of DMS which allow greater geographical coverage than mesocosm experiments. This has been done resulting in a doubling of the data. Results from shipboard incubation experiments in the North West European shelf show a consistent decrease in DMSP and an increase in DMS

with increasing CO_2 , as well as an increase in stress induced algal processes indicating a lack of adaptation to CO_2 change. A completely different response was observed in polar waters compared to temperate waters. There was a weak DMS response to high CO_2 at all polar regions. Metanalysis of data from all cruises show resilience of polar communities to abrupt variations in carbon chemistry (i.e. ocean acidification), therefore, a DMS response could be a strong indicator of the level of acclimation of a community to carbonate chemistry variability. A number of single species culture studies show fairly inconsistent findings but there is potential for these studies to tell us more.

8.19 Other important trace gases, not as extensively studied as DMS, are halocarbons. These are also precursors to aerosol and ozone formation and have a role in radiative forcing. Three mesocosm experiments in temperate, polar and Baltic regions showed no effect of ocean acidification on bromocarbons but a 70% decrease in iodocarbons in the temperate region only. In the case of other GHGs like N_2O (part of marine N cycle) and CH_4 , there is some experimental evidence of a decrease in nitrification and denitrification with ocean acidification and potential deoxygenation (hypoxic/suboxic regions are expanding). The way forward for ocean acidification (multiple stressors) research is to shift focus from single to multiple drivers, from single species to communities/ecosystems, and from acclimation to adaption. In terms of non- CO_2 trace gases, look at unknown gases, carry out longer term experiments to understand evolutionary adaptation, focus on key trace gas flux regions, and further integrate research in the lab, field and modelling.

8.20 Following questions and comments from the audience, it was added that the addition of carbon from other sources (melting permafrost, river input) will carry more carbon into the Arctic ocean. The reduction of sea ice creates a reef around the coasts so as they melt there will be more coastal erosion and then you have the methane clathrates (a large amount of methane trapped within a crystal structure of water), which may become a significant source of CH_4 and/or CO_2 . In other words, you get acidification from the top and the bottom. With respect to the relationship between DMS production and other compounds, it was mentioned that iron fertilization may sometimes result in additional production of DMS but is not a given. DMS has a cooling effect on the climate so this is a positive outcome. A question was raised as to what the impact of changes in DMS may be on the sulphur cycle. Based on modelling climate scenarios, changes in DMS due to ocean acidification may be as much as 10 to 50%, however, future climate scenarios that took warming into account showed an overall reduction in DMS.

Discussion

8.21 The discussion started with a question about whether it is better to improve climate/carbon system models or to improve resolution of observations. The 0.1 degree model has promise to provide a better representation of physical systems. Carbonate system representation in the models is good but the ecosystem component is primitive (at most two or three phytoplankton groups). Limitations to this would be the computational capacity and the understanding of

biology and how it responds to multiple stressors. There is knowledge coming out but it is still a work in progress and an exciting question to think about.

8.22 Blue carbon stores (carbon captured by the world's oceans and coastal ecosystems) are becoming more prominent in policy discussions. We do not know how important this and other carbon sources are. There are interesting papers coming in but it is not currently possible to quantify this. UN Environment and GRID-Arendal produced an assessment on Blue Carbon. Policy may be moving ahead of science in this case so we need to bring science up to speed. The 1.5 degree target is an example of policy moving ahead of science and it had a great impact on the scientific focus.

8.23 In terms of what we know about the carbon that will be transported from the surface ocean to the deep ocean, Earth system models consider this to some extent but it is difficult to disentangle effects. As the carbon moves down the water column through various processes it gets remineralized by bacteria at the bottom producing CO₂ while some gets buried in the deep sediment. It is very difficult for modellers to have an estimate of the ocean carbon biological sink and any changes to it because they need the biological input. All processes within models have to be based on empirical research which is the constrain in model development. This is what the WCRP Grand Challenge on Carbon Feedbacks is working on.

8.24 Ocean acidification will also be important for Large Marine Ecosystems (LMEs). The Sustainable Development Goals include a target (14.3) on ocean acidification. The Global Ocean Acidification Observing Network (GOA-ON) and the IAEA Ocean Acidification International Coordinator Centre provide training and produce measurements and maps that inform models and guide to best experiment practices so we can link chemical observations with local impacts. This is a huge undertaking and it would be great if all of this work could be rolled up to give more power to the most vulnerable people. The Ocean Conference highlighted the importance of aligning SDGs with the UNFCCC agenda. It was noted there is quite a growing interest among Member States on SDG 14.3 but not necessarily funding of this SDG. GOA-ON is already creating a structure on how the SDG targets can be assessed but they need to secure more funding to do this. Several regional science groups are being created under GOA-ON to do science and look at adaptation responses and they are at various stages of progression. No compilation currently exists on best practices on adaption measures to cope with ocean acidification.

8.25 The 0.4 pH decrease simulated to occur by end of century would kill off coral reefs but there may be instances were due to local conditions some organisms will survive but overall the ocean will not be good place and there will be changes in productivity, fisheries migration, etc.

Action taken by GESAMP

8.26 The event helped to enhance knowledge of the current understanding of global carbon, the impacts of CO₂ and related stressors on the ocean ecosystem, and ocean feedbacks in the climate system. Informed

discussions on these issues are taking place outside of GESAMP.

9 DATE AND PLACE OF GESAMP 45

9.1 GESAMP accepted gratefully the offer by FAO to host the 45th session of GESAMP in 2018 and that the exact dates would be confirmed by the ExCom as soon as possible.

10 FUTURE WORK PROGRAMME

10.1 GESAMP discussed the work programme for the intersessional period including imminent tasks for each working group. The currently active GESAMP working groups, correspondence groups and task teams are listed, with their current terms of reference are set out at Annex V.

11 ANY OTHER BUSINESS

11.1 GESAMP noted that Ms Silvina Carou would be leaving her post at WMO shortly following the annual session, and expressed the deepest gratitude on behalf of GESAMP and ExCom for her services to as the WMO Technical Secretary for GESAMP over the last three years. Ms Carou's commitment to the Group, and not least to WG 38 and the hosting of working group meetings and this annual session, were recognized as an outstanding example of the kind of cooperation and dedication that makes GESAMP a unique advisory body.

12 ELECTION OF CHAIRPERSONS

12.1 GESAMP unanimously re-elected Mr Peter Kershaw as Chairperson and Mr Manmohan Sarin as Vice-Chairperson for the intersessional period and the forty-fifth session of GESAMP.

13 CONSIDERATIONS AND ADOPTION OF THE REPORT OF GESAMP 44

13.1 The report of the forty-fourth session of GESAMP was considered and approved.

14 CLOSURE OF THE SESSION

14.1 The Chairperson of GESAMP, Mr Peter Kershaw, closed the forty-fourth session of GESAMP on Thursday, 7 September 2017 at 5:00 p.m.

ANNEX I - Provisional agenda

PROVISIONAL AGENDA

44th session of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)
World Meteorological Organization (WMO)
Geneva, Switzerland, from 4 to 7 September 2017

Monday, 4 September

Morning session (closed session)

Informal meeting of the members of GESAMP
Initial meeting of the Executive Committee of GESAMP (ExCom)

Afternoon session

Opening of the 44th session of GESAMP

- 1 ADOPTION OF THE AGENDA
- 2 REPORT OF THE CHAIRPERSON OF GESAMP
- 3 REPORT OF THE ADMINISTRATIVE SECRETARY OF GESAMP
- 4 PLANNING OF GESAMP ACTIVITIES:
 - .1 Evaluation of the hazards of harmful substances carried by ships (WG 1: IMO leading)
 - .2 Review of applications for "active substances" to be used in ballast water management systems (WG 34: IMO leading)

Tuesday, 5 September

Morning session

- .3 Atmospheric input of chemicals to the ocean (WG 38: WMO leading)
- .4 Establishment of trends in global pollution in coastal environments (WG 39: IAEA leading)
- .5 Sources, fate and effects of micro-plastics in the environment – a global assessment (WG 40: IOC-UNESCO and UN Environment co-leading)
- .6 Marine geoengineering (WG 41: IMO leading)

Afternoon session

- .7 Impacts of wastes and other matter in the marine environment from mining operations, including deep-sea mining (WG42: IMO and UN Environment co-leading)
- 5 CONTRIBUTIONS TO OTHER UN PROCESSES

Wednesday, 6 September

Morning session

Presentations by observers

- 6 IDENTIFICATION OF NEW AND EMERGING ISSUES REGARDING THE DEGRADATION OF THE MARINE ENVIRONMENT OF RELEVANCE TO GOVERNMENTS AND SPONSORING ORGANIZATIONS

Afternoon session

- 8 GESAMP SIDE EVENT: "CO₂ in the atmosphere-ocean system: impacts and feedbacks".

Thursday, 7 September

Morning session

- 7 SCOPING ACTIVITIES

CG 1: The environmental impact of disinfection by-products

CG 2: The impacts of chronic hydrocarbon contamination

CG 3: The causes and impacts of massive outbreaks of Sargassum seaweed in the Caribbean, Brazil and West Africa

CG 4: The impact of pharmaceutical and other novel chemicals in wastewater

CG 5: The extent and impacts of onshore and offshore sand mining

- 9 DATE AND PLACE OF GESAMP 45

- 10 FUTURE WORK PROGRAMME

Afternoon session

- 11 ANY OTHER BUSINESS

- 12 ELECTION OF CHAIRPERSONS

- 13 CONSIDERATION AND ADOPTION OF THE REPORT OF GESAMP 44

- 14 CLOSURE OF THE SESSION (AT 5:30 P.M.)

Friday 8 September (closed session)

Morning session

Concluding meeting of the Executive Committee of GESAMP (ExCom)

ANNEX II - List of documents

Agenda item 1

- 44/1/Rev.1 Provisional agenda (Revised)
- 44/1/1 Annotations to the provisional agenda
- 44/INF.1 List of participants

Agenda item 2

- 44/2 Report of the Chairperson of GESAMP

Agenda item 3

- 44/3 Report of the Administrative Secretary of GESAMP
- 44/3/Add.1 Report of the Administrative Secretary of GESAMP – (input from UN Environment)

Agenda item 4

- 44/4 Report of the Co-Chairpersons of Working Group 38: Atmospheric input of chemicals to the oceans
- 44/4/1 Report of the Chairperson of Working Group 1: Evaluation of the Hazards of Harmful Substances Carried by Ships
- 44/4/2 Report of the Ballast Water Working Group (Working Group 34):
Review of applications for “Active Substances” to be used in ballast water management systems
- 44/4/3 Report of the Chairperson of Working Group 39:
Establishment of trends in global pollution in coastal environments
- 44/4/4 Report of the Chairperson of Working Group 40 – Sources, fate and effects of [micro-plastics^e and]
micro-plastics in the marine environment – A global assessment
- 44/4/5 Report of the Co-Chairperson of Working Group 41: Marine geoengineering
- 44/4/6 Report of the Chairperson of Working Group 42: Impacts of wastes and other matter in the marine
environment from mining operations, including deep-sea mining
- 44/4/7 Planning of GESAMP activities: Review of applications for “Active Substances” to be used in ballast water
management systems

Agenda item 5

- 44/5 Contributions to other UN Processes – Briefing paper on the development of the IOC proposal for an
International (UN) Decade of Ocean Science for Sustainable Development
- 44/INF.2 Global Ocean Science Report

Agenda item 7

- 44/7 CG1: Scoping paper on the relevance of ballast water related production of disinfection by-products
(DBPs) against other inputs of DBPs in the aquatic environment

^e Suggested addition to WG title, for discussion at G44, Geneva, September 2017

- 44/7/1 CG2: Scoping on the impact of hydrocarbon to the marine environment and public health
- 44/7/2 CG3: Causes and impacts of massive accumulations of the brown macro-algae Sargassum in the nearshore environment of the Caribbean and West Africa
- 44/7/3 CG5: Sand and gravel mining – new insights on an emerging environmental problem
- 44/7/4 CG4: The impacts of pharmaceuticals and other novel chemicals on wastewater

ANNEX III – List of participants

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ANNEX IV - Activities and achievements by the Sponsoring Organizations of GESAMP during the intersessional period

This document provides a summary of the Sponsoring Organizations' achievements since GESAMP 43 (14 to 17 November 2016) from IMO, IAEA, UNESCO-IOC, UNDP, FAO, DOALOS, WMO, and UN Environment.

INTERNATIONAL MARITIME ORGANIZATION (IMO)

Implementation of the Ballast Water Management Convention

1 The Ballast Water Management (BWM) Convention was adopted in February 2004 and aims to prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments. The entry into force conditions of the BWM Convention were met on 8 September 2016 by the accession of Finland and the Convention will therefore enter into force on 8 September 2017. The number of Contracting Governments is currently 63, representing 68.51% of the world's merchant fleet tonnage.

Matters directly related to the GESAMP-BWWG

2 IMO's Marine Environment Protection Committee (MEPC), at its 71st session, granted Basic Approval to two and Final Approval to one ballast water management systems (BWMS) that make use of Active Substances, based on the recommendations of the 34th meeting of the GESAMP Ballast Water Working Group (BWWG). In total there are around 70 type-approved BWMS available.

3 Having considered the report of the Eighth Stocktaking Workshop of the GESAMP-BWWG (STW 8), MEPC 71, inter alia, endorsed several recommendations by the GESAMP-BWWG including a revision of the GESAMP-BWWG Methodology. Some of the most important outcomes are outlined in the following paragraphs.

4 MEPC 71 agreed to a procedure for submission of new data on fresh water testing of BWMS with Final Approval, which will immediately start being applied by the GESAMP-BWWG.

5 MEPC 71 also endorsed the recommendation of the GESAMP-BWWG that, in all cases where ballast water management involves the addition of an Active Substance to drinking water on board, there should be a submission for approval under the *Procedure for approval of ballast water management systems that make use of Active Substances* (G9).

6 Following a recommendation by the GESAMP-BWWG on the need to review Procedure (G9) and make it mandatory, as a consequence of the review and decision to make the *Guidelines for approval of ballast water management systems* (G8) mandatory, MEPC 71 requested the GESAMP-BWWG to specify what amendments it recommends to Procedure (G9).

7 Finally, MEPC 71 approved the revised Methodology for information gathering and conduct of work of the GESAMP-BWWG (BWM.2/Circ.13/Rev.4), which will be applied to all submissions for Basic Approval to MEPC 74 and onwards, and subsequent submissions for Final Approval of those systems.

Other matters

8 In light of the imminent entry into force of the BWM Convention, MEPC 71 dealt with an extraordinary number of topics related to ballast water management and made a large number of relevant decisions, including approval of draft amendments to the Convention for adoption after its entry into force and a BWMS Code. The Secretary-General will circulate the amendments upon entry into force of the Convention, with a view to adoption at MEPC 72 along with the BWMS Code. A summary of the most important outcomes is provided in this section.

Amendments to regulation B-3 of the BWM Convention

9 MEPC 71 approved draft amendments to regulation B-3 of the BWM Convention, to provide an appropriate timeline for ships to comply with the ballast water performance standard described in regulation D-2 of the Convention, and a draft MEPC resolution on *Determination of the date referred to in regulation B-3, as amended, of the BWM Convention*. MEPC 71 also adopted resolution MEPC.287(71) on *Implementation of the BWM Convention* with a view to facilitating the smooth and uniform implementation of the amendments to regulation B-3.

Code for approval of ballast water management systems

10 In adopting the revised Guidelines (G8), MEPC 70 had agreed that they should be made mandatory after the entry into force of the BWM Convention and renamed as "Code for approval of ballast water management systems" (BWMS Code). MEPC 71 approved the BWMS Code and related draft amendments to regulations A-1 and D-3 of the BWM Convention making the Code mandatory.

11 MEPC 71 also approved in principle consequential amendments to the *Guidance on scaling of ballast water management systems* (BWM.2/Circ.33) and the *Guidance for Administrations on the type approval process for ballast water management systems in accordance with Guidelines (G8)* (BWM.2/Circ.43), to be kept in abeyance for final approval at MEPC 72 in conjunction with the adoption of the BWMS Code.

Guidance on various issues

12 Having considered relevant proposals, MEPC 71 approved the following new circulars:

- .1 BWM.2/Circ.61 on *Guidance on methodologies that may be used for*

enumerating viable organisms for type approval of ballast water management systems;

- 2 BWM.2/Circ.62 on *Guidance on contingency measures under the BWM Convention*, noting that the *Guidelines for Ballast Water Management and development of Ballast Water Management plans (G4)* should be consequently reviewed as a part of the experience-building phase associated with the BWM Convention; and
- 3 BWM.2/Circ.63 on *Application of the BWM Convention to ships operating in sea areas where Ballast Water Exchange in accordance with regulations B-4.1 and D-1 is not possible*.

13 Moreover, MEPC 71 approved revised *Guidance on entry or re-entry of ships into exclusive operation within waters under the jurisdiction of a single Party (BWM.2/Circ.52/Rev.1)*.

Survey and certification

14 The *Interim Survey Guidelines for the purpose of the BWM Convention under the Harmonized System of Survey and Certification (BWM.2/Circ.7)* had been kept in abeyance until the BWM Convention enters into force. MEPC 71 instructed the Sub-Committee on Implementation of IMO Instruments at its next session (III 4, scheduled from 25 to 29 September 2017) to incorporate the aforementioned Interim Survey Guidelines in the next amendment of the HSSC Guidelines, with a view to submission to the IMO Assembly's forthcoming meeting (A 30, scheduled from 27 November to 6 December 2017) for adoption. In addition, MEPC 71 instructed III 4 to introduce provisions in the HSSC Guidelines for validating the compliance of individual BWMS with regulation D-2 of the BWM Convention in conjunction with their commissioning.

15 MEPC 71 also approved draft amendments to regulations E-1.1.5, E-5.8 and E 5.9.1 of the BWM Convention, related to endorsements of additional surveys on the International Ballast Water Management Certificate (IBWMC), and a unified interpretation of Appendix I of the BWM Convention (Form of the IBWMC) on how the IBWMC should be completed.

Revision of Guidelines on ballast water exchange and risk assessment

16 MEPC 71 adopted amendments to the *Guidelines for ballast water exchange (G6)*, to incorporate a ballast water reporting form, and the *Guidelines for risk assessment under regulation A-4 of the BWM Convention (G7)*, to better clarify the relationship between the Guidelines and the same risk area (SRA) concept. The two revised Guidelines were adopted through resolutions MEPC.288(71) and MEPC.289(71), respectively.

"Ballast Water Management – How to do it" manual

17 A manual titled "Ballast Water Management – How to do it" was being developed by the Sub-Committee on Pollution Prevention and Response

(PPR) over a number of sessions and the Sub-Committee's work was concluded at its latest session (PPR 4, 16 to 20 January 2017). MEPC 71 finalized and approved the manual for publication, which will be carried out as soon as possible by the IMO Secretariat.

Experience-building phase

18 Having considered the report of a correspondence group that had been established to further develop the experience-building phase associated with the BWM Convention, including developing a plan for gathering and analysing data, MEPC 71 adopted resolution MEPC.290(71) on *The experience-building phase associated with the BWM Convention*, and encouraged Member States and interested parties to commence the data gathering associated with the experience-building phase at their earliest convenience, in anticipation of the future approval of the data gathering and analysis plan.

Future work

19 Being the first session of the Marine Environment Protection Committee after the entry into force of the BWM Convention, MEPC 72 (scheduled from 9 to 13 April 2018) is primarily expected to adopt the amendments to regulations A-1, B-3, D-3, E-1 and E-5, as well as the BWMS Code. MEPC 72 is also expected to deal with other issues related to ballast water management, including issues emanating from the PPR Sub-Committee and the GESAMP-BWWG.

Amendment of the Anti-fouling Systems Convention

20 The Anti-fouling Systems (AFS) Convention was adopted in October 2001 and aims to prohibit the use of harmful anti-fouling paints used on ships. The Convention entered into force on 17 September 2008 and the number of Parties is currently 76, representing 93.70% of the world's merchant fleet tonnage. The Convention has not been amended since its entry into force.

21 At present, Annex 1 to the AFS Convention prohibits the use of organotin compounds acting as biocides in anti-fouling paints used on ships, and has a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. In this context, MEPC 71 considered a proposal to amend Annex 1 to the Convention, to include controls on cybutryne, and agreed to include a relevant new output in the PPR Sub-Committee's biennial agenda for 2018-2019 and the provisional agenda for PPR 5 (scheduled from 5 to 9 February 2018), which will consider the initial proposal. The outcome of the deliberations of PPR 5 will be considered by MEPC 72, which will determine how the matter will progress further.

Biofouling management

22 The Biofouling Guidelines were adopted in July 2011 and are intended to provide a globally consistent approach to the management of biofouling, which is the accumulation of various aquatic organisms on ships' hulls, in order to minimize the transfer of invasive aquatic species. Biofouling management can

also be an effective tool in enhancing energy efficiency and reducing air emissions from ships.

23 The IMO Secretariat has developed and submitted to the Global Environment Facility (GEF), through UNDP, a proposal for a project titled "Building Partnerships to Assist Developing Countries Minimize the Impacts from Aquatic Biofouling" (GloFouling Partnerships). This proposal was approved by the GEF Council in May 2017 and the IMO Secretariat is now in the process of developing the full project document, with a view to the project starting in the second half of 2018.

MARPOL Annex I (Prevention of pollution by oil)

Unified interpretations of regulations 1.23 and 36.2.10 of MARPOL Annex I

24 MEPC 71 approved unified interpretations of regulation 1.23 concerning the regulatory deadweight to be entered on relevant statutory certificates, and of regulation 36.2.10 concerning categorizing of terminal hose flush water from a Single Point Mooring (SPM) or a Conventional Buoy Mooring (CBM) as the disposal of residues under regulation 36.2.10.

Protecting the Arctic from heavy fuel oil

25 MEPC 71 agreed to add a new output in its work programme on the development of measures to reduce risks of use and carriage of heavy fuel oil (HFO) as fuel by ships in Arctic waters. This new output will appear on the agenda for its next session (MEPC 72) in April 2018.

26 Member Governments and international organizations were invited to submit concrete proposals on what type of measures should be developed, including the scope of the work, to MEPC 72, so that clear instructions can be given to the PPR Sub-Committee which will carry out the detailed technical work, starting at PPR 6 in 2019.

27 The use and carriage of heavy fuel oil is banned in Antarctic waters under MARPOL Annex I and the Polar Code recommends that Member States follow the same practice in the Arctic.

Ship recycling

28 Following the adoption of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, in May 2009, the MEPC has finalized and adopted all six guidelines required under the terms of the Convention to facilitate the global implementation of its requirements in a uniform and effective manner. Thus the whole package for Member Governments to ratify the Convention is in place. To date, six States, i.e. Belgium, Denmark, the Congo, France, Norway and Panama have ratified or acceded to the Convention, whose combined merchant fleets constitute 21.23 % of the gross tonnage of the world's merchant fleet, and whose combined ship recycling volumes constitute 112,161 gross tonnage.

Review of MARPOL Annex V (Garbage)

29 The revised MARPOL Annex V was adopted by resolution MEPC.201(62) and entered into force on 1 January 2013, thus establishing a prohibition on the discharge of all types of garbage into the sea except in the cases explicitly permitted under the Annex.

30 MEPC 70 adopted further amendments to MARPOL Annex V related to products which are hazardous to the marine environment (HME) substances and Form of Garbage Record Book, with an expected entry into force date of 1 March 2018. The amendments provide criteria for the classification of solid bulk cargoes as harmful to the marine environment and are aimed at ensuring that such substances are declared by the shipper if they are classed as harmful and are not discharged.

31 MEPC 71 adopted the *2017 Guidelines for the implementation of MARPOL Annex V* (resolution MEPC.295(71)), revoking its 2012 Guidelines. The main purposes of these Guidelines are to assist: (1) governments in developing and enacting domestic laws which implement Annex V; (2) shipowners, ship operators, ships' crews, cargo owners and equipment manufacturers in complying with requirements set forth in Annex V and relevant domestic laws; and (3) port and terminal operators in assessing the need for, and providing, adequate reception facilities for garbage generated on all types of ships.

Issues related to MARPOL Annex II and IBC Code

32 MEPC 69 adopted amendments to the appendix to MARPOL Annex II, which updated the summary table, setting out the revised GESAMP Hazard Evaluation Procedure.

33 MEPC 70, having noted the concurrent decision by MSC 96 approved a Unified interpretation which aimed to facilitating global and consistent implementation of survival requirements of the IBC Code (MSC-MEPC.5/Circ.11). The Committee also approved an *Example of a Certificate of Protection for products requiring oxygen-dependent inhibitors* (MSC-MEPC.2/Circ.16), further to concurrent approval by MSC 96.

OSV Chemical Code

34 MEPC 71 approved the draft Code for the transport and handling of hazardous and noxious liquid substances in bulk on offshore support vessels (OSV Chemical Code), for submission to the thirtieth IMO Assembly for adoption later this year.

MARPOL Annex VI (Prevention of air pollution from ships)

Consistent implementation of regulation 14.1.3 of MARPOL Annex VI

35 MEPC 70, having approved a final report of the assessment of fuel oil availability, decided that the sulphur content limits for fuel oil in regulation 14.1.3 of MARPOL Annex VI shall become effective on 1 January 2020.

36 In this regard, MEPC 71 approved a new output on "Consistent implementation of regulation 14.1.3 of MARPOL Annex VI" and agreed the scope of work needed, for inclusion in the PPR Sub-Committee's biennial agenda for 2018-2019.

37 In addition, MEPC 71 also approved the holding of an intersessional meeting on consistent implementation of regulation 14.1.3 of MARPOL Annex VI, under the PPR Sub-Committee, in the second half of 2018, subject to endorsement by the Council.

Fuel oil quality

38 MEPC 67, following a discussion on fuel oil quality, established a correspondence group to develop draft guidance on quality-assurance for fuel oil delivered for use on board ships and to consider the adequacy of the current legal framework in MARPOL Annex VI in relation to fuel oil quality. MEPC 69, having considered a report of the group, re-established the correspondence group to further develop draft guidance on best practice for fuel oil purchasers/users and Member States/coastal States and instructed it to submit a report to MEPC 71.

39 MEPC 71, having considered a report of the correspondence group, further developed draft guidance on best practice for fuel oil purchasers/users, with a view to finalization at MEPC 72, and re-established the correspondence group to further develop draft best practice for Member States/coastal States and instructed it to submit a report to MEPC 73.

EEDI review

40 Amendments to MARPOL Annex VI, regulations for the prevention of air pollution from ships, adding a new chapter 4 to Annex VI on regulations on energy efficiency for ships to make mandatory the Energy Efficiency Design Index (EEDI), for new ships, and the Ship Energy Efficiency Management Plan (SEEMP) for all ships entered into force on 1 January 2013.

41 Regulation 21.6 of MARPOL Annex VI requires, at the beginning of phase 1 (1 January 2015), the Organization to "review the status of technological developments and, if proven necessary, amend the time periods, the EEDI reference line parameters for relevant ship types and reduction rates set out in this regulation". MEPC 67 established a correspondence group to review the status of technological developments relevant to implementing phase 2 of the EEDI regulatory framework which begins in January 2020.

42 MEPC 70 considered a final report of the correspondence group and, following consideration, agreed to retain the current reduction rates, time periods and the EEDI reference line parameters of EEDI phase 2 requirements for ship types other than ro-ro cargo ships and ro-ro passenger ships. MEPC 70 further agreed that it would be necessary to start a thorough review of EEDI phase 3 requirements (1 January 2025 and onwards), including discussion on its earlier implementation and the possibility of establishing a phase 4. Currently, phase 3 requirements provide that

new ships be built to be 30% more energy efficient compared to the baseline.

43 MEPC 71, having considered EEDI phase 2 requirements for ro-ro cargo and ro-ro passenger ships, approved draft amendments to regulation 21 of MARPOL Annex VI regarding EEDI requirements for ro-ro cargo and ro-ro passenger ships, with a view to adoption at MEPC 72.

44 MEPC 71 also established a correspondence group on review of the Energy Efficiency Design Index (EEDI) beyond phase 2, to report on progress by MEPC 72 and make a recommendation to MEPC 73 on the time period and reduction rates for EEDI phase 3 requirements.

Amendments to MARPOL Annex VI and associated guidelines

45 MEPC 71, having considered draft amendments to MARPOL Annex VI, adopted:

- .1 Amendments to MARPOL Annex VI to designate the North Sea and the Baltic Sea as emission control areas for nitrogen oxides (NO_x) Tier III control with an effective date of 1 January 2021, including exemption provisions to allow ships fitted with dual fuel engines or with only Tier II engines to be built, converted, repaired and/or maintained at shipyards located in NO_x Tier III ECAs; and
- .2 Amendments to the information to be included in the bunker delivery note (appendix V to MARPOL Annex VI) relating to the supply of marine fuel oil to ships which have fitted alternative mechanisms to address sulphur emission requirements.

46 MEPC 71 also adopted 2011 Guidelines addressing additional aspects to the NO_x Technical Code 2008 with regard to particular requirements related to marine diesel engines fitted with selective catalytic reduction (SCR) systems.

Further technical and operational measures to enhance energy efficiency

47 MEPC 68 agreed that the development of a data collection system for ships should follow a three-step approach, consisting of data collection and data analysis, followed by decision-making on what further measures, if any, are required. This approach was reaffirmed by MEPC 69 and led to the approval of draft amendments to chapter 4 of MARPOL Annex VI to introduce a mandatory data collection system for fuel oil consumption of ships.

48 MEPC 70 adopted amendments to Chapter 4 of MARPOL Annex VI including a new regulation 22A on a mandatory data collection system for fuel oil consumption. Under the amendments, ships of 5,000 gross tonnage and above will be required to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data including proxies for transport work. The aggregated data will be reported to the flag State after the end of each calendar year and the flag State, having determined that the data

has been reported in accordance with the requirements, will issue a Statement of Compliance to the ship. Flag States will be required to subsequently transfer this data to an IMO Ship Fuel Oil Consumption Database. IMO will be required to produce an annual report to the MEPC, summarizing the data collected.

49 MEPC 71, having considered necessary guidelines for uniform implementation of data collection system for fuel oil consumption:

- .1 Adopted 2017 Guidelines for Administration verification of ship fuel oil consumption data;
- .2 Adopted 2017 Guidelines for the development and management of the IMO Ship Fuel Oil Consumption Database; and
- .3 Approved an MEPC circular on Submission of data to the IMO data collection system for fuel oil consumption of ships from a State not Party to MARPOL Annex VI.

Reduction of GHG emissions from ships

50 UNFCCC Parties attending COP 21 adopted the 2015 Paris Agreement on Climate Change. MEPC 70 welcomed the entry into force of the Paris Agreement on 4 November 2016.

51 MEPC 70, following consideration, approved a Roadmap for developing a *Comprehensive IMO strategy on reduction of GHG emissions from ships*, which foresees an initial GHG reduction strategy to be adopted in 2018. The Roadmap contains a list of activities, including further IMO GHG studies and significant intersessional work, with relevant timelines and provides for alignment of those new activities with the ongoing work by the MEPC on the three-step approach to ship energy efficiency improvements. This alignment provides a way forward to the adoption of a revised strategy in 2023 to include short-, mid-, and long-term further measures, as required, including implementation schedules. Subsequently, the first intersessional working group (ISWG-GHG 1) was held from 26 to 30 June 2017.

52 MEPC 71 noted the draft outline of the structure of the initial IMO GHG Strategy, and approved the terms of reference for the second and third meetings of the Intersessional Working Group on reduction of GHG emissions from ships (ISWG-GHG 2 and ISWG-GHG 3) to be held in October 2017 and April 2018 respectively.

53 MEPC 71 welcomed the progress achieved and invited Member States and international organizations to continue this work in a constructive and efficient manner at the two forthcoming intersessional meetings, with a view to the adoption of the initial Strategy at MEPC 72 (spring 2018).

Oil pollution preparedness and response

54 The OPRC-HNS Technical Group, at its twelfth session, agreed to establish a correspondence group (CG) under the leadership of Canada and France with a view to revising the IMO Dispersant Guidelines in light of latest developments, especially, the Deepwater

Horizon incident. The parts of the guidelines dealing with surface application of dispersants have now been approved by MEPC, with the remaining part devoted to Sub-Sea dispersant application currently under development. This part takes into account the experience gained from the Deepwater Horizon incident as well as the subsequent scientific studies and technical developments initiated by the public sector and the industry. This final part of the IMO Dispersant Guidelines is expected to be considered by the PPR 5, in February 2018.

55 MEPC 70 agreed to include a new output, the development of a "Guide on practical methods for the implementation of the OPRC Convention and OPRC-HNS Protocol" in the post-biennial agenda of the Committee, and work is expected to commence on this guidance document during PPR 5.

London Convention and Protocol (LC/LP)

56 Since the 43rd session of GESAMP, the following developments may be of interest to GESAMP. The Scientific Groups of the LC/LP met for their joint annual session (LC 40/LP 12) from 27 to 31 March 2017, at IMO headquarters.

Disposal of fibreglass vessels

57 The Scientific Groups noted that further information on the disposal of fibreglass vessels was needed, and recommended a collation of information on the scale of the problem, through the means of a literature review, in order to identify key knowledge gaps relating to impacts of fibre-reinforced plastic vessels dumped or placed in the marine environment.

Specific guidelines for assessment of platforms or other man-made structures at sea

58 The Groups initiated the revision of the *Specific guidelines for assessment of platforms or other man-made structures at sea*, through an intersessional correspondence group on the revision of the specific guidelines, under the lead of Norway, with assistance from Canada. The target dated for completion of the revision is 2019.

Riverine and marine disposal of tailings and associated wastes from mining operations and deep seabed mining

59 The Scientific Groups noted the progress made by GESAMP on the issue of impacts of wastes and other matter in the marine environment from mining operations, including deep-sea mining, as well as the establishment of a GESAMP working group (WG 42) under the co-lead of IMO and UN Environment.

Marine litter and microplastics

60 The Scientific Groups held an extensive discussion, and considered several informative submissions on the topic of microplastics, in particular in relation to the monitoring and assessment of dredged material and sewage sludge. The Groups agreed that Parties should redouble efforts to share knowledge and technical expertise with regard to the analysis of plastics, including microplastics, in dredged material

and sewage sludge (in particular), with a view to developing methods to enable routine, reliable monitoring, assessment and reporting of microplastic contaminant levels in such waste streams as soon as possible.

Science Day 2017

61 As part of the joint session, a half-day seminar took place on the "Waste prevention audits", which focussed on the importance of waste prevention audits within the process of assessing wastes and reducing marine pollution, and the concern raised over the issue of microplastics and how they could be addressed in future through the LC/LP.

Joint session of the Scientific Groups

62 The next meeting of the governing bodies of the LCLP will be held from 9 to 13 October, at IMO Headquarters. The next joint session of the LC/LP Scientific Groups is tentatively scheduled for late April/early May 2018.

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

63 IAEA Environment Laboratories (NAEL) report on activities at its 3 marine profile laboratories: Marine Environmental Studies Laboratory (MESL), Radioecology Laboratories (REL) and Radiometrics Laboratory (RML).

Marine Environmental Studies Laboratory (MESL) Activities

Production of Certified Reference Materials and Interlaboratory Comparison exercises

64 Two Certified Reference Materials (CRM) were produced: i) CRM IAEA-459 (persistent organic contaminants in marine sediment); ii) CRM IAEA-436 (trace elements and methyl mercury in fish sample). A new CRM - IAEA 476 for trace elements and methyl mercury in biota sample is under production and a characterization and homogeneity studies are ongoing. IAEA's CRMs are produced to assist Member States improving quality of measurement results in the analysis of trace elements, Methyl Mercury and persistent organic pollutants in marine environmental samples, in view of assessing pollution levels and trends and enhancing seafood safety.

65 NAEL participated in the proficiency tests for trace elements and organic pollutants in marine samples organized by the Quasimeme. NAEL participated also in the GEOTRACES interlaboratory comparison for the determination of ultra-low levels of mercury and methylmercury in the open ocean.

Strengthening data quality assurance of Regional Seas laboratories participating in marine monitoring programmes

66 NAEL provided technical support for strengthening the capability of Mediterranean laboratories to accurately analysing contaminants in marine samples in the framework of the MED POL

programme. MED POL is the Programme for the Assessment and Control of Pollution in the Mediterranean Region of UNEP/Mediterranean Action Plan. Designated national monitoring laboratories in Mediterranean countries benefit by being able to use the analytical support of NAEL in the development in their quality assurance programmes for the determination of trace elements and organic contaminants in marine environment.

67 NAEL organized two Proficiency Tests to assist Member States strengthening data quality assurance in laboratories participating in marine pollution monitoring programmes. In total 60 laboratories from 16 Member States participated in these exercises:

- .1 Analytical Performance Study for MEDPOL: Determination of trace elements in marine sediment sample: 28 laboratories from 14 Mediterranean Member States (Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Montenegro, Morocco, Slovenia, Tunisia, Turkey); and
- .2 Two Analytical Performance Study for MEDPOL: Determination of chlorinated pesticides, PCBs and petroleum hydrocarbon in marine biota sample: 32 laboratories from 14 Mediterranean Member States (Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Italy, Lebanon, Montenegro, Morocco, Slovenia, Spain, Tunisia, Turkey).

68 NAEL organized two training courses on the analysis of contaminants in marine samples:

- .1 Training workshop on the analysis of Trace Elements in marine samples for laboratory practitioners in MEDPOL countries, 24/10-4/11/2016 (6 trainees from 6 Mediterranean Member States); and
- .2 Training workshop on the analysis of Organic Contaminants in marine samples for laboratory practitioners in MEDPOL countries, 24/10-4/11/2016 (5 trainees from 5 Mediterranean Member States).

69 One scientist from Sri Lanka Atomic Energy Authority visited NAEL laboratory and was trained on the analysis of stable isotopes of Carbon and Nitrogen using Isotopic Ratio Mass Spectroscopy (IRMS). The training was provided in the framework of the IAEA's Technical Cooperation Project SRL7005 (Sri Lanka). One scientist from Philippine Nuclear Research Institute was trained on the production of Certified Reference Materials. One scientist from the National Institute of Metrology, LNE France and one scientist from Polish Geological Institute made scientific visits to NAEL to be informed on the latest developments related to the analysis of trace elements, mercury and methylmercury using ICP-MS and GC-AFS techniques respectively.

70 NAEL hosted the Thirteenth Expert Meeting of Bonn-OSINet, the Bonn Agreement Oil Spill Identification Network of Experts to promote the stable isotopes methodologies for fingerprinting oil and other emerging contaminants.

71 A new agreement between IAEA/NAEL and UNEP/MAP to continue the collaboration on strengthening data quality assurance in marine pollution monitoring in the Mediterranean region is under final discussion. Already two Proficiency Tests and two Training Courses are under preparation. The project is ongoing and will be completed within 2017.

72 A Practical Arrangement, for collaboration on data quality assurance and traceability of mercury measurements in marine environment was signed between IAEA NAEL and the French Institute of Metrology LNE, Paris, France in February 2017.

73 Practical Arrangement for collaboration on environmental forensic studies, based on high level trace elements isotopic ratios measurements in marine environment was signed between IAEA/NAEL and the University of Warsaw, Poland in January 2017.

Developing tools for assisting Member States to analyse contaminants and long lived radionuclides in marine samples and to identify their sources

74 NAEL continued the development and validation of monitoring methods, which were published in peer-reviewed journals and presented in International Conferences: i) Method for emerging contaminants in sea water: case study of the rare earth elements; ii) Method for lead isotopic ratios in seawater; iii) Method for ultralow-levels Th²³² in seawater; iv) Method for toxic elements in biota samples, based on solid sampling; v) Method for dissolved and particulate petroleum hydrocarbons and their stable carbon isotopes in seawater. Analytical methodologies developed in NAEL for emerging and regulated contaminants and for the determination of stable isotope ratios in the marine environment were promoted via 8 publications in peer-review journals/books and 10 presentations at scientific conferences.

75 To help in the implementation of the Minamata Convention NAEL continued the development, validation and dissemination of recommended analytical methods for monitoring mercury and methyl mercury in the marine environment. Several methods dealing with the determination of mercury and methylmercury in seawater by application of different analytical techniques have been recently validated.

76 A number of analytical methods are under validation including the determination of: i) low level trace elements in seawater; and ii) petroleum hydrocarbons and organochlorinated compounds in sediments and biota samples.

77 A worldwide interlaboratory comparison on determination of trace elements and methyl mercury in marine biota samples is ongoing and will be finalized by the end of 2017.

Radioecology Laboratory (REL) activities

Strengthening capabilities for biotoxin monitoring in seafood through research and development, training and cooperation

78 The receptor binding assay for harmful algal bloom (HAB) toxin detection continues to be in full

operation at NAEL for research and development applications and for technology transfer and capacity building. NAEL laboratory performance is assessed through successful participation to Quasimeme proficiency testing (PT) exercises for paralytic shellfish poisoning. The RBA method is also being used to study biotoxin food web transfer and metabolism. It is being optimized for application to the emerging ciguatera toxins and its proficiency assessed on new seafood sample matrices to broaden its regulatory application. The RBA method was put in operation in a new country in 2017 (Morocco) where it is being assessed as a potential replacement of the mouse bioassay, currently in use for regulatory purposes.

79 NAEL provides technical and scientific support to over 40 Member States (MSs) in Latin America, Asia-Pacific and Africa to build capacity in HABs management through 12 national and regional technical cooperation projects. NAEL continues to host fellowships and internships to transfer the RBA technology to IAEA MSs (total of 8 individuals in 2016 from Indonesia, Philippines, Morocco, Tunisia, Cuba, and France, and 2 individuals, 6 months each in 2017). NAEL is joining efforts with other national and international organizations (IOC-UNESCO, US-NOAA, Malarde Institute in French Polynesia, IFREMER France, IRTA Spain) to improve knowledge and enhance capabilities in HABs management and participates actively at the International Panel on HABs.

80 Member State participants (Cuba, Thailand, Brazil, France, and Spain) of the Coordinated Research Project (CRP) on the application of the RBA techniques for improving coastal management met at IRTA Spain in 2017. A major achievement included: i) the sampling and screening of over 60 fish for the preparation of a reference fish matrix material; ii) the establishment of first culture of toxic benthic HABs from Cuba; iii) findings of high diversity of benthic toxic genera of ostreopsis associated with a mass mortality of sea-urchin and iv) raising risk for ciguatera poisoning with the findings of Gambierdiscus species in North and South East coast of Brazil. CRP project findings were communicated through five presentations at international conferences.

81 The Philippine Nuclear Research Institute was re-designated as an IAEA collaborating centre to work on HABs in the context of environmental and global change. The plaque was inaugurated during the 2016 General Conference in Vienna. In this framework and with the support of a PUI project, the capacity of PNRI was enhanced with the purchase and setup of an LC-MS/MS.

82 With the support of a PUI project (funded by the United States) on "Capacity building for the detection and quantification of PSP and CFP toxins in seafood for the management and the mitigation of HABs impacts Phase II", a field sampling mission is being prepared in collaboration with the Marshall Islands Marine Resources Authority (MIMRA) at Ailinglaplap coral atoll in the Marshall Islands in view of preparing fish matrix reference material for Pacific Ciguatoxins.

83 Research findings and IAEA activities on HABs were communicated through over 10 publications

in journals, international conference proceedings, technical reports or online news articles and student theses. We will highlight the publication of a joint IAEA-IOC/UNESCO Manual and Guide for Designing and Implementing a Plan to Monitor Toxin Producing Microalgae.

Partnership with the Collaborative Research Centre, SFB 754, at the University of Kiel, Germany

84 SFB 754 addresses the threat of ocean deoxygenation and its consequences on the global climate-biogeochemistry system. Originally, the low oxygen content of oxygen minimum zones (OMZ) is due to a natural process of enhanced oxygen consumption related to the remineralization of sinking organic matter produced in the nutrient rich surface waters. Some of the richest fisheries in the world supported by these nutrient rich surface waters are predicted to be highly impacted by the oxygen decline.

85 After two intensive field work campaigns in upwelling areas off the coast of Peru and Mauritania, NAEL participated in February 2015 in the SFB 754 science retreat to exchange and discuss recent results. NAEL will continue the collaboration with scientists involved in SFB754, to further contribute with more detailed data on carbon fluxes to the ongoing studies of the climate-biogeochemistry system.

Research and development of nuclear application for studying contaminants and essential elements in marine biotas

86 NAEL continued to use radiotracers to investigate bioaccumulation of contaminants and essential elements in marine organisms and to assess seafood safety concerns of Agency Member States. The focus for this period was on: (1) factors affecting accumulation of trace metals in farmed fish; (2) effect of multiple stressors (ocean acidification, hypoxia, temperature in parallel with metals, toxins and radionuclides contamination) on fish and corals; (3) the dynamic of caesium contamination and depuration in sediment; and (4) caesium incorporation in various invertebrates and fish. For the caesium experiments, the NAEL REL team investigated the exposure of different marine species through various exposure pathways to better understand the fate of accidental releases of this radionuclide into the marine environment, and to be able to address the following key questions, How is caesium accumulated? What is the major pathway and what is the transfer mechanism through the food chain? What is the overall environmental risk? The results of these studies will help to better understand, for example, the high levels found in the tissue samples of some species in Fukushima using laboratory experiments and modelling. A project on marine microplastics as vector for contaminant transfer to marine organisms has been initiated and first experiments will start in 2017.

Activities of IAEA NAEL's "Ocean Acidification International Coordination Centre (OA-ICC)"

87 The IAEA NAEL OA-ICC continues to help advance international activities in ocean acidification science, capacity building and communication.

88 A regional workshop addressing the impacts of ocean acidification and adaptation strategies in the Red Sea and the Gulf of Aden was organized in Jeddah, the Kingdom of Saudi Arabia, 18-20 January 2016, in partnership with the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). The aim of the workshop, which gathered 30 participants representing 7 countries from the region, was to raise awareness about ocean acidification and its potential socio-economic impacts, assess needs for training, and identify opportunities for regional and international cooperation on OA monitoring. The OA-ICC also supported a practical training course on ocean acidification on the island of Inhaca, Mozambique, 8-12 February 2016. The course was organized by the University of Gothenburg (Sweden) and the Global Ocean Acidification Observing Network (GOA-ON) and focused on ways of setting up meaningful ocean acidification experiments with limited infrastructure and resources. In addition, discussions continued to advance the development of an African ocean acidification network (OA-AFRICA) as initiated at the OA-ICC training course in South Africa (Cape Town, 2-6 November 2015). Fifteen students from 9 African countries participated in the course.

89 A group of 20 early-career scientists representing 11 nations in Latin-America and the Caribbean attended an OA-ICC training course on ocean acidification, 5-10 September 2016, Ensenada, Mexico, organized in partnership with the Center for Scientific Research and Higher Education of Ensenada (CICESE) and the Autonomous University of Baja California (UABC). The training course sought to give participants entering the field of ocean acidification a solid theoretical framework and practical hands-on experience needed to set up meaningful experiments. An additional goal was to offer the participants networking opportunities for future collaborative research projects in Latin America and the Caribbean, including through the recently launched Latin American Ocean Acidification Network (LAOCA).

90 The OA-ICC also supported a more advanced, practical workshop on carbonate system measurements specifically targeted to countries involved in LAOCA, held at Universidad Autónoma de Baja California, Ensenada, Mexico, from 3-10 December 2016. Six young researchers from four IAEA Member States (Argentina, Brazil, Ecuador and Peru) were able to deepen their knowledge in ocean acidification observing system design, carbonate chemistry measurement methodology, handling and calibration of instruments and sensors, and use of carbonate system computing tools.

91 In addition to training, the project also continued to provide opportunities for scientists from developing Member States to attend key international conferences to present their work on ocean acidification, network with colleagues and initiate collaborations. The project supported 4 scientists from 3 IAEA developing Member States to attend a special session on ocean acidification and its interaction with other ocean change drivers at the MARES Conference "Marine Ecosystems Health and Conservation", Olhão, Portugal, 1-5 February 2016. The OA-ICC also supported the attendance of eight early-career scientists from six IAEA Member States (Brazil,

Barbados, El Salvador, India, Kenya and Philippines) at the Global Conference on Climate Change Adaptation for Fisheries and Aquaculture (FishAdapt), 8-10 August 2016, Bangkok, Thailand.

92 The OA-ICC co-sponsored the largest international gathering on ocean acidification - the 4th International Symposium on the Ocean in a High-CO₂ World - hosted in Hobart, Australia, 3-6 May 2016, by the University of Tasmania, Institute for Marine and Antarctic Studies (IMAS), New Zealand, and the Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia. The event, held only every four years, discussed the key latest developments in ocean acidification science, identified future research needs and trends, and offered prime networking opportunities to hundreds of scientists working on ocean acidification from all over the world. Thanks to the support of the OA-ICC, 16 scientists from 11 developing IAEA Member States were able to attend the Symposium and present their research. The OA-ICC also provided an exhibition booth showcasing the project's work and resources provided to the ocean acidification community.

93 The OA-ICC co-organized the 3rd GOA-ON Science Workshop, which followed the Symposium on the Ocean in a High-CO₂ World (8-10 May). The workshop brought together more than 100 scientists from 40 countries and discussed GOA-ON national and regional status, linkages to other global programmes, data management, capacity building etc. Sponsored by the OA-ICC, six researchers from IAEA Members States had the opportunity to present their work and explore opportunities for cooperation with GOA-ON members from across the globe. The project also organized the first in-person meeting of the GOA-ON Biology Working Group, 10-11 October 2016 at the IAEA Environment Laboratories in Monaco. The meeting brought together 14 participants from 9 countries and identified three tasks needed to advance biological OA monitoring:

- .1 provide a biologist's perspective on an ocean acidification observing network;
- .2 revisit the requirements of an ocean acidification biological monitoring programme; and
- .3 develop a biological index allowing to link biogeochemical changes to ecosystem impacts.

94 The Fourth Annual Meeting of the OA-ICC Advisory Board took place on 2 May 2016 in Hobart, Australia, taking advantage of the presence of many of its members on the occasion of the 4th International Symposium on the Ocean in a High-CO₂ World. The Board discussed the project's activities and achievements over the past year, and identified areas for improvement and priorities for the future.

95 After two OA-ICC expert meetings on international data management in 2015, work have progressed with partners to advance data portals on both observing (via GOA-ON) and biological response OA data. Prototypes were show-cased at the various meetings in Hobart mentioned above.

96 The OA-ICC also continued to work actively to coordinate discussions and efforts to develop simplified methodology to study ocean acidification, both in the laboratory and in the field. An expert meeting on ocean acidification research methodologies, organized in the framework of the IAEA Technical Cooperation project "Supporting a Global Ocean Acidification Observing Network – Towards Increased Involvement of Developing States" (INT7019), was convened 12-14 October 2016 at the IAEA Environment Laboratories in Monaco. The goal of the meeting was to advance discussions on the development of simplified protocols and ocean acidification «starter kits», in particular for research institutes with limited infrastructure and capacities.

97 The project hosted the first meeting of the "Oceans Solutions Initiative" Working Group in Monaco, 22-24 November 2016. The goal of the initiative is to contribute to the next IPCC assessment by reviewing four clusters of potential solutions to ocean acidification and climate change (mitigation, protection, repair, and adaptation) by assessing their relevance in terms of efficiency, feasibility, benefits and potential risks.

98 Two young researchers from Namibia and South Africa were supported by the OA-ICC to speak at a side event entitled: "From the U.S. West Coast to the Ivory Coast: Building Scientific and Political Capacity to Respond to Ocean Acidification", organized by the U.S. Department of State at the UNFCCC COP22, 9 November 2016, Marrakech, Morocco. The event highlighted efforts to address ocean acidification in Africa and showcased some of the activities previously organized by the OA-ICC and its international partners. The OA-ICC also contributed to a multi-partner exhibition booth at COP22, led by the Plymouth Marine Laboratory aiming to bring the science of ocean acidification and warming to decision makers. Building on success at previous COPs, the stand was trilingual (English, French, Arabic) and featured the policy briefing document «Hot, sour and breathless: ocean under stress», alongside other useful information and films.

99 Finally, work on the online OA-ICC resources continued on a day-to-day basis with updates of the OA-ICC News Stream and Website, as well as the OA-ICC Bibliographic Database, now containing 4300 references, and the OA-ICC Data Compilation on the Biological Response to Ocean Acidification, now offering access to 907 data sets from 852 scientific articles. An article describing the data compilation was published in the journal «Earth System Science Data» in February 2016.

Radiometrics Laboratory (RML) activities

IAEA's project for "Marine Monitoring: Confidence Building and Data Quality Assurance"

100 With a view to assisting the Government of Japan in its objective of making the Sea Area Monitoring Plan comprehensive, credible and transparent, the IAEA, through its Environment Laboratories, is helping to ensure the high quality of data and to prove the comparability of the results. A 3-year project 'Marine Monitoring: Confidence Building and Data Quality Assurance' (2014-2016) was initiated

as a follow-up activity to recommendations made on marine radioactivity monitoring in a report issued by the IAEA in 2013 which reviewed Japan's efforts to plan and implement the decommissioning of the Fukushima Daiichi Nuclear Power Station. Six sampling missions and interlaboratory comparisons (ILCs) and three proficiency tests (PTs) were organized during this project. The project was concluded with a report published in 2017 showing that Japan's sample collection procedures follow the appropriate methodological standards required to obtain representative samples. The results obtained in ILCs demonstrate a high level of accuracy and competence on the part of the Japanese laboratories involved in the analyses of radionuclides in marine samples for the Sea Area Monitoring programme, corroborating the conclusions of the PTs. The project was extended for a period of 4 years.

IAEA Regional Technical Cooperation project RCA RAS/07/028 (Asia-Pacific) "Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems"

101 This is a new IAEA Regional Technical Cooperation Project running in the Asia-Pacific region under the "Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific" (RCA) aiming to improve the integrated regional quality-assured capabilities for marine radioactivity monitoring and for impact assessment of routine and accidental releases of radioactivity into the marine environment. The project, which runs between 2017-2020, is training scientists and laboratory staff from the region in analytical and assessment techniques for radioactivity in seawater, sediment and biota.

IAEA Regional Technical Cooperation project RAF7015 (Africa) "Strengthening Regional Capacities for Marine Risk Assessment Using Nuclear and Related Techniques"

102 Due to the transboundary nature of marine pollution this project aims at assisting Member States to determine the sources of contaminants on a national and regional scale and to strengthen their capacities to analyse radionuclides, organic and inorganic pollutants in marine samples for assessing marine pollution and risk for humans. The objectives of the project are to complement and strengthen the regional capacities for monitoring marine pollution and for risk assessment using nuclear and related techniques to address trans-boundary pollution for sustainable use of marine ecosystem services and enhance socio-economic benefits and to generate national and regional databases for decision makers. Eighteen Member States are strongly cooperating in employing an integrated regional approach for effective marine monitoring. NAEL technically supports the implementation of the project by providing expertise in radionuclides measurement, QA/ QC aspects, trace elements contamination in marine organisms and seafood safety issues.

IAEA Regional Technical Cooperation project RAF7017 (Africa) "Promoting Technical Cooperation among Radio-Analytical Laboratories for the Measurement of Environmental Radioactivity"

103 The project is aiming to enhance the competency of the Member States in the monitoring and assessment of the environmental impact of nuclear and NORM industries. Specific objectives of the project are to establish an integrated regional quality-assured capability for the radioactivity analysis of environmental samples and to improve the competency of laboratories for the analysis of environmental samples via increased collaboration between the members of the ALMERA-Africa regional group of the world-wide network of Analytical Laboratories for the Measurement of environmental Radioactivity (ALMERA) and mentorship by advanced laboratories in the ALMERA network. Thirty two Member States are involved in a wide range of project activities related to radioanalytical techniques and quality management. NAEL technically supports the implementation of the project by providing expertise in radionuclides measurement and QA/QC aspects.

IAEA Technical Cooperation project MHL7001 "Developing a National Radioactivity Monitoring Capacity in the Marshall Islands"

104 This project has been designed to build capacity in the Marshall Islands to enable local scientists to undertake environmental radioactivity monitoring and to provide advice on radiation exposure and subsequent health consequences. The radioactive source of most concern in the Marshall Islands is the residual contamination resulting from the use of some of the islands in the 1940s and 1950s by the USA as atmospheric nuclear weapons test sites. An important objective of the project is to assist the Marshall Islands' technical personnel in addressing concerns and a current lack of understanding by the public regarding the nuclear weapons testing-related legacy issues. Therefore, there will be a strong emphasis on public engagement. The IAEA Environment Laboratories conducted an expert mission to the atoll in December 2016 to review existing sampling and laboratory capabilities and protocols and to help define the requirements for establishing a national radioactivity monitoring capability. Training and procurement of radiometric equipment has been undertaken in 2017. The project is due for completion in December 2017. A follow-up project – MHL2016002 – which aims to continue to develop this capacity has been planned for 2018 to 2021.

Analytical quality services

105 Production of Certified Reference Materials for radionuclides in marine samples: A new IAEA reference material is the final phases of the certification process and will be available in 2018: IAEA-465 Radionuclides in Baltic Sea sediment.

106 Proficiency Testing: After finalizing 5 PTs in between 2012 and 2016, the IAEA will organize in 2017 a sixth PT exercise with seawater samples spiked with H-3, Sr-90, Co-60, Cs-134 and Cs-137. Approximately

sixty participants will take part in the 2017 proficiency test.

MARIS database

107 In 2016-2017 the IAEA's MARine information System (MARIS), an open-access global database for marine radioactivity measurements accessible on Internet (maris.iaea.org), is entering a new phase of development and update. Development areas include adding new data, updating and improving the website, and interacting with the wider environmental data networks. To improve data discoverability and accessibility, there are plans to link to the out-facing data portal GEOSS (Global Earth Observation System of Systems). In response to the increasing need to educate the wider general audience on the topic of marine radioactivity and the issues surrounding it FAQ pages were developed to be launched in 2017. In addition MARIS is engaged with the RiO5 working group – Radioactivity in the Oceans, 5 Decades Later – that is supported by SCOR, the Scientific Committee on Oceanic Research. In 2017, MARIS was updated with the 2017 HELCOM (Baltic Marine Environment Protection Commission - Helsinki Commission) MORS (Monitoring of Radioactive Substances) database, and will form a central part of the data collection effort of IAEA's Coordinated Research Project (CRP) K41017 "Behaviour and Effects of Natural and Anthropogenic Radionuclides in the Marine Environment and their Use as Tracers for Oceanography Studies".

IAEA CRP K41015: "Radioanalytical and isotopic studies of climate trends and variability in marine paleo-records"

108 This 4 years CRP was initiated in 2017, following the recommendations of an expert's meeting held in 2016 at the IAEA. The project aims to use paleo proxy records to study trends and variability in past climate. It will build upon the previous CRP "Nuclear and isotopic studies of the El Niño phenomenon in the ocean", which used nuclear and isotopic tool to study the El Niño effect in the Pacific Ocean. This new CRP will expand and take a broader temporal and spatial scope to include the study of other lower-frequency climate phenomena found in different ocean regions. The CRP will focus on the second part of the Holocene (0–5000 yBP) with emphasis on the more recent time period (0–1500 yBP), and there is scope to link this time period to more recent samples that overlap the instrumental record for the purposes of calibration, comparison and application to present day climate issues (1950 is the established reference date for 0 yBP (years before present)). The first Research Coordination Meeting was held at the Environment Laboratories in Monaco in March 2017.

IAEA CRP K41016 project "Study of temporal trends of pollution in selected coastal areas by the application of isotopic and nuclear tools"

109 GESAMP suggested that the IAEA supports the development and implementation of nuclear applications to coastal pollution studies. A CRP proposed in 2008 as an unfunded activity, was finally initiated in 2016. The main aim of the CRP is to develop new insights on the application of isotopic and nuclear tools in the study of temporal trends of pollution in

coastal areas. The overall objective of the CRP is to provide Member States with improved and harmonised environmental archive dating tools to evaluate sources and temporal trends of pollutants, which will enable them to sustainably manage their coastal marine environment. Specific research objectives are to establish a scientific platform to improve the radiometric dating methods for defining time-trends of pollution, to verify the improved and harmonized common approach on a broad range of case studies in selected coastal areas with high sedimentation rates and to appraise pollution sources using stable- and radio- isotopes. After a 4 years period it is expected to achieve a streamlined, harmonised and validated methodology for sediment dating which will assure reliable, high quality, comparable data on temporal trends of pollutants from coastal areas in different geographical regions.

IAEA CRP K41017: "Behaviour and Effects of Natural and Anthropogenic Radionuclides in the Marine Environment and their Use as Tracers for Oceanography Studies"

110 This CRP aims to develop and apply methods combining advanced and rigorous data treatment and modelling approaches for determination of spatial and temporal patterns, behaviour and effects of radionuclides in the marine environment in order to provide Member States with methodological guidance, data and information on levels, trends, effects of radionuclides and their applications to oceanographic process studies. The expected outcomes of this CRP include improved guidance for IAEA Member States for assessing marine radioactivity according to harmonized, best practice methodologies; an updated, comprehensive understanding of the behaviour and effects of natural and anthropogenic radionuclides in the global marine environment and of processes affecting their distributions and increased capacity for the application of radiotracer techniques to oceanographic research. The CRP started in 2017 and is due for completion in 2022.

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC of UNESCO)

Global Ocean Science Report (GOSR)

111 On World Oceans Day, 8 June 2017, IOC-UNESCO presented the first ever global stocktaking of marine science at the United Nations' Ocean Conference in New York. The Global Ocean Science Report identifies and quantifies the key elements of ocean science at the national, regional and global scales, including workforce, infrastructure and publications. It is the first collective attempt to systematically highlight opportunities as well as capacity gaps to advance international collaboration in ocean science and technology. Developed as a resource for policymakers, academics and other stakeholders seeking to harness the potential of ocean science to address global challenges, the Report makes a case for increased funding in view of the ocean's economic importance and key role in regulating the climate.

112 To be published every five years, the inaugural Report also serves as an instrument to assess progress

in the accomplishment of Sustainable Development Goal (SDG) 14 on the conservation and use of the oceans, seas and marine resources. The full Report, in English, as well as the Executive Summary, in the six official UN languages, are available online.

Ocean acidification

113 Ocean acidification (OA) is a global concern and is a risk to marine biodiversity, ecosystems and human society, and in order to improve the knowledge and close existing observation gaps in this regard IOC-UNESCO is an active member in the Global Ocean Acidification Observing Network (GOA-ON). IOC-UNESCO particularly supports the development of improved recommendations regarding biological observation to measure the impact of ocean acidification is strongly supported by the IOC-UNESCO. One element is the co-leadership in the biological working group of GOA-ON).

114 IOC further hosted the annual Executive Council meeting of GOA-ON in April 2017 at UNESCO Headquarters. This meeting was used to outline the upcoming goals and objectives, to plan future actions (e.g. the implementation plan, capacity building activities), but also to advance with the methodology for the SDG indicator 14.3.1, which addresses ocean acidification.

115 IOC participated and co-organized several side events related to ocean acidification at the Preparatory committee of the UN Ocean Conference in February 2017 and at the conference in June 2017 itself. IOC's is highly involved and partner in several voluntary commitments related to ocean acidification – e.g. #OceanAction15274; #OceanAction16542, #OceanAction15798.

116 GOA-ON has now 354 members, from 64 countries (2015: 150 scientists, 31 countries) and is constantly growing. New members from Latin America (members from: Chile, Venezuela, Ecuador, Nicaragua) and the Western Pacific (members from: Philippines, Malaysia, South Korea, Thailand, China, Palau, Indonesia, Micronesia, Fiji, Hong Kong) joined the network since the 43rd session of GESAMP. In addition, a strong increase in African scientists joining the network was noticed. While before only experts from South Africa participated in the network now researchers from: Angola, Mozambique, Kenya, Nigeria, Algeria, Cameroon, Senegal, Egypt, Ivory Coast, Congo, Namibia, South Africa, Mauritius, Tanzania and Nigeria are part of the group.

117 The IOC, IOC-WESTPAC, established an Ocean Acidification Observing Working Group in the Western Pacific in 2015/2016. With adapted guidelines for measuring the chemical and biological impacts of ocean acidification, this group of experts started chemical measurements and deployed the devices needed to detect the effects of increasing CO₂ concentrations on coral growth and survival.

118 In 2016, the platform of the UNFCCC COP22 was used to raise awareness for ocean acidification, highlighting the anthropogenic impact on marine environment, which going to lose its capacity to act as a carbon sink. During the conference several high-level

side events and workshops were organized with the support of IOC, resulting in an improved profile of IOC within the scientific and political community.

119 All these activities feed into the actions undertaken by IOC to equip countries to fulfil the agenda 2030, SDG 14 to protect the ocean and its resources.

Blue Carbon

120 The Blue Carbon Initiative, established in 2011 by the IOC, the International Union for the Conservation of Nature (IUCN) and Conservation International (CI) works to develop management approaches, financial incentives and policy mechanisms for ensuring the conservation, restoration and sustainable use of coastal blue carbon ecosystems. The IOC is highly involved in the Blue Carbon Scientific Working Group, which provides the scientific foundation for the Blue Carbon Initiative by synthesizing current and emerging science on blue carbon and by providing a robust scientific basis for coastal carbon conservation, management and assessment. Priority research of the Scientific Working Group functions in close partnership with the Initiative's Policy Working Group.

121 IOC is further one coordinating member of the International Blue Carbon Partnership, a unique body which brings together governments, NGOs, IGOs and UN-Agencies.

122 IOC-UNESCO supported the organization of related side events at the Preparatory committee of the UN Oceans Conference in February 2017 and at the conference in June 2017 itself. In collaboration with the Blue Carbon Partnership these events gave the opportunity to connect high level representatives and scientists to raise awareness for the central role of these ecosystem for carbon sequestration. IOC is further partner in a Blue Carbon Voluntary commitment - #OceanAction15003.

123 The 2016 annual workshop of the scientific working group of the Blue Carbon Initiative with the support of IOC-UNESCO, took place in Manado, Indonesia, September 2016.

De-oxygenation

124 De-oxygenation is a global problem in coastal and open regions of the ocean, and has led to expanding areas of oxygen minimum zones and coastal hypoxia. In the coastal ocean, the number of reported dead zones has increased exponentially since the 1960s with more than 600 systems now. The recent expansion of hypoxia in coastal ecosystems has been primarily attributed to global warming and enhanced nutrient input from land and atmosphere. The global extent and threat to human health and marine ecosystem services of ocean deoxygenation are just beginning to be appreciated; the social and economic consequences have yet to be determined but are likely to be significant. To create awareness towards the impacts of deoxygenation on the marine environment and finally ocean and human health an IOC expert group – the Global Ocean Oxygen Network- was formed. After the establishment of the Global Ocean Oxygen Network (GO2NE) at the 49th session of the

IOC Executive Council a draft of a technical brief, summarizing the threat of decreasing oxygen concentrations in the coastal seas and open ocean is completed. This publication is currently in its final stages and will be published in September/October 2017. The first working group workshop was hosted by IOC in September 2016 and a half-day workshop was conducted at the 10th International Scientific WESTPAC Conference, which resulted in the formation of a regional WESTPAC O2NE (Western Pacific Ocean Oxygen Network). To increase the awareness among policy makers about the risk of low oxygen areas in the coastal and open ocean, the impacts on ecosystem services, ocean and human health, GO2NE organized a side event at the UN Oceans Conference in June 2017. This event also highlighted the voluntary commitment submitted by IOC with regard to deoxygenation - #OceanAction15767. Furthermore, GO2NE is further participating in the organization committee of the international conference 'Ocean Deoxygenation: Drivers and Consequences – past – present – future, in Kiel, Germany, 3-7 September 2018.

Time Series

125 Since 2013 the establishment of an interdisciplinary IOC working group, the International Group for Marine Ecological Time Series (IGMETS), has offered the possibility to improve model projections and forecasts needed to understand open ocean and coastal changes. IGMETS has delivered several products as a global map, a global assessment, and an interactive visualizer. This group of experts was decided to be supported during the 49th session of the IOC Executive Council. IGMETS focuses on ship based time series globally, analyzing phyto- and zooplankton together with nutrients and physical information (temperature, salinity), and couples these global observations with synoptic satellite data to obtain spatially distributed information. The information provided addresses new scientific questions and serves a well-established community of practice related to ship-based time series. The IGMETS report will publish its report in September 2016.

126 As from 2016 an affiliated group has worked specifically to investigate Climate Change and Global Trends of Phytoplankton in the ocean, in particular the coastal ocean (TrendsPO). The Group continues the comparative analysis and synthesis of long time series data sets compiled by SCOR WG137, and expands the focus not only to the continental shelf and open oceans, but also to estuarine and upstream freshwater ecosystems where perturbations from terrestrial, atmospheric, oceanic sources and human activities converge to cause changes that ramify across local and global scales. The Group examines the land and sea connectivity using long time series of available data.

Harmful Algal Blooms

127 A number of Task Teams, working groups and activities are operating and reporting to the IOC Intergovernmental Panel on HABs (IPHAB). Several of the groups contribute to the development of a '*Global HAB Status Report*' with the aims of compiling an overview of HAB events and their societal impacts; providing a worldwide appraisal of the occurrence of

toxin-producing microalgae; and assessing the status and probability of change in HAB frequencies, intensities, and range resulting from environmental changes at the local and global scale. The development of this report is intimately linked with the systematic compilation of HAB data in OBIS and the IOC Harmful Algal Event Data base HAEDAT and is funded by Flanders and cosponsored by the IAEA.

128 Another key activity under IPHAB is on Ciguatera Fish Poisoning (CFP) which the most extensive human illness caused by harmful algae. The IPHAB has initiated the development of a UN Coordinated Ciguatera Strategy involving the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA), and the World Health Organization (WHO).

129 The long term focus of the IOC Harmful Algal Bloom (HAB) programme is on improved understanding of the factors controlling HAB events and thereby improving management and mitigation options. The scientific key questions have for more than a decade been addressed jointly with the Scientific Committee on Oceanic Research (SCOR) through research programmes. The current decadal IOC-SCOR research programme to meet societal needs in a changing world is entitled GlobalHAB and launched in May 2017 its science and implementation plan (www.globalhab.info).

IOC Joint action with ICES and IMO on Ballast and other Ship Vectors

130 The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) critically reviews and reports on the status of shipping vector research with an emphasis on new developments in ballast water treatment technology, risk assessment, ballast water sampling devices, and selection of ballast water exchange zones. The WG also discusses and evaluates the sampling strategies to ensure that international guidelines are based on accurate scientific information, thereby helping to achieve consensus on difficult and technical issues. The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) met at the NOAA Northeast Fisheries Science Center in Woods Hole, USA, on 15–17 March 2017, including a joint meeting on 15 March with the Working Group on Introductions and Transfers of Marine Organisms (WGITMO). WGBOSV considered two ToRs jointly with WGITMO, examining biofouling as vector for the introduction and transfer of aquatic organisms on small boats and large ships (ToR e) and examining the effect of climate change on the establishment of aquatic species in the Arctic (ToR d).

131 WGBOSV members have submitted numerous manuscripts about methods for collection and analysis of ballast water samples to a special issue in the Journal of Sea Research, and developed a submission to the International Maritime Organization concerning the type of scientific data that should be collected during the experience-building phase after entry-into-force of the ballast water convention. Two additional scientific review papers were initiated and progressed intersessionally. One new recommendation came out of the meeting: to formalize the role of the International Maritime Organization (IMO) with the WGBOSV and to formalize the cooperation between ICES, IMO and

Intergovernmental Oceanographic Commission (IOC) through a submission from ICES Secretariat to IMO Secretariat. As last year's recommendation to initiate discussion/coordination with other Arctic organizations (e.g. PAME, CAFF) with a view to jointly address non-native species issues in the Arctic has not yet been responded to, it has been restated in this report.

132 Full report at: <http://www.ices.dk/community/groups/Pages/WGBOSV.aspx>

Nutrient's Coastal Impacts Research

133 Nutrient over-enrichment of coastal ecosystems is a major environmental problem globally, contributing to problems such as harmful algal blooms, dead zone formation, and fishery decline. Yet, quantitative relationships between nutrient loading and ecosystem effects are not well defined. The IOC Nutrients and Coastal Impacts Research Programme (N-CIRP) is focussing on integrated coastal research and coastal eutrophication, and linking nutrient sources to coastal ecosystem effects and management in particular. A key component in the implementation strategy is a four-year Joint UNEP-IOC Global Environment Facility (GEF) Project "Global foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution" which was launched in March 2012. The IOC is leading the Project research component which delivers global and local models for impact of nutrient loading. As part of the implementation strategy for N-CIRP, IOC also actively participates in a UNEP led "Global Partnership on Nutrient Management" (GPNM) with intergovernmental organizations, non-governmental organizations and governments. GPNM has an online information portal to enable GPNM partners to monitor progress on implementing activities related to the sustainable use of nutrients. The platform provides a knowledge hub, networking opportunities and promotes global discussions on sustainable nutrient management.

Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-Economic Aspects – World Ocean Assessment

134 The 1st World Ocean Assessment report under the United Nations was finalized in December 2015 and released in January 2016. Hundreds of scientists from many countries, representing various disciplines and steered by a 22-member Group of Experts, examined the state of knowledge of the world's ocean and the ways in which humans benefit from and affect it

135 IOC contributed to this effort by providing scientific and technical support throughout this five-year process. In December 2016, the UN General Assembly (UNGA A/RES/71/257) following the recommendations of the Ad Hoc Working Group of Whole decided to launch a new cycle of assessment, WOA-II (2016-2020). The Ad Hoc Working Group also adopted a Programme of Work for the period 2017-2020.

136 As part of its decision, the UNGA established a new Group of Experts to carry out the assessment, building on an international pool of experts. It also called for the appointment of national focal points to

facilitate the implementation of the programme of work of the second cycle of the Regular Process, in particular with respect to the nomination process for additional experts to the Pool of Experts, the swift communication between the scientific community, the Group of Experts, the Pool of Experts, the Bureau and the secretariat of the Regular Process, as well as awareness-raising matters.

137 The programme of work for the period 2017-2020 for the second cycle of the Regular Process, which was adopted by the Ad Hoc Working Group of the Whole on the Regular Process at its meeting from 3 to 9 August 2016 and endorsed by the General Assembly in its resolution 71/257 of 23 December 2016 on "Oceans and the Law of the Sea" (paragraph 299), envisages a total of ten regional workshops to be held in two rounds beginning from the second half of 2017 and continuing into 2018. These workshops will serve to, inter alia, raise awareness, provide information, and receive feedback on the First Global Integrated Marine Assessment ("World Ocean Assessment I"), generate interest from the scientific community, contribute to capacity-building and inform the scoping and preparation phases and the collection of regional-level information and data for the preparation of the assessment(s) of the second cycle. In order to facilitate the holding of workshops for the second cycle of the Regular Process, the Bureau of the Ad Hoc Working Group requested the Group of Experts to review the applicability of the Guidelines to the first round of regional workshops of the second cycle of the Regular Process since the focus of the workshops is different from those of the first cycle. In that regard, the Group of Experts was requested to either revise the Guidelines, or prepare new Guidelines as required. The Group of Experts has prepared elements for new Guidelines which were approved by the Ad Hoc Working Group at its meeting of 17-18 April 2017. It also considered and adopted the terms of reference and working methods for the Group of Experts for the second cycle.

138 Pursuant to paragraphs 299 and 307 of General Assembly resolution 71/257, the Group of Experts also prepared three Technical Abstracts based upon World Ocean Assessment I. These are meant to provide a way to share WOA - I findings and support other ocean-related intergovernmental processes, namely the 2030 Agenda for Sustainable Development; General Assembly resolution 69/292: Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ); and the United Nations Framework Convention on Climate Change.

139 The 2016 UNGA resolution also invited IOC as well as other UN bodies to assist in the implementation of the second cycle of the Regular Process with regard to the following activities: awareness-raising, the identification of experts for the Pool of Experts, technical and scientific support to the Bureau and the Group of Experts, hosting workshops and meetings of the writing teams, capacity-building and the scoping process for the assessment(s) of the second cycle.

140 To respond to the UNGA invitation to continue supporting the Regular process, the IOC may continue

to provide support to the Regular Process in the following manner:

- .1 engaging IOC Member States and their experts into the Process, particularly to encourage new nominations to the dedicated pool of expert that will support the WOA-II implementation;
- .2 assistance with the information (incl. communication) and data management aspects of WOA-II;
- .3 the co-organization of regional workshops on the Regular Process through IOC's Regional Subsidiary Bodies;
- .4 the conduct of capacity-building activities related to marine assessment in view of regional requirements, possibly in cooperation with UN Environment;
- .5 the provision of assessment products, results and data upon request from the lead authors and experts in charge of the WOA report preparation;
- .6 hosting of group of experts meetings and/or writing team meetings;
- .7 support to the WOA report editorial process; and
- .8 communication to scientific community and IOC Member States on the objectives of the Regular Process.

Transboundary Water Assessment Programme

141 IOC completed the implementation of the marine components of the Transboundary Water Assessment Programme (TWAP) funded by GEF. From the IOC perspective, TWAP is the first integrated and global marine assessment that the Commission is leading, and the results produced have the potential to inform a number of ocean governance mechanisms; these include the GEF, other UN agencies with an ocean mandate, other global assessment processes such as WOA and Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES), regional seas organizations, and LME commissions, as well as Member States. In order to conduct this assessment, IOC established a consortium of institutional partners and experts for the current Open Ocean and LMEs assessments (these include for e.g. NOAA, IGBP, GESAMP, UNEP-WCMC, University of British Columbia, National Center for Ecological Analysis and Synthesis (NCEAS), amongst others).

142 The final TWAP deliverables released in July 2016, include a set of technical assessment reports for LMEs and Open Oceans, as well as summary for decision-makers, and a data portal where indicators can be visualized and data downloaded (www.onesharedocean.org).

143 The TWAP Full size project as implemented by UNEP as Implementing Agency, UNEP's Division of Early Warning and Assessment (DEWA) as Executing

Agency, and the following lead agencies for each of the water system categories: the International Hydrological Programme (IHP) of the UNESCO for transboundary aquifers including groundwater systems in small island developing states (SIDS); the International Lake Environment Committee Foundation (ILEC) for lake basins; UNEP-DHI Partnership - Centre on Water and Environment (UNEP-DHI) for river basins; and the IOC/UNESCO for large marine ecosystems (LMEs) and the open ocean. The institutional partnerships forged in this assessment are envisioned to seed future transboundary assessments.

OBIS

144 Between May 2016 and May 2017, the Ocean Biogeographic Information System (OBIS) grew with 133 datasets to a total of 48.4 million records, and not less than 45 publications have cited OBIS in the first half of 2017. OBIS is organized around national, regional and thematic OBIS nodes, which are responsible for the data flow from data providers to the central OBIS node, including ensuring the quality of the data. The OBIS secretariat at the IODE project office integrates all the data in a central, open-access database.

145 Two new OBIS nodes were established in the first half of 2017. The Institute of Oceanography and Environment (INOS) of the University of Malaysia Terengganu joined the OBIS network as the OBIS node in Malaysia. INOS is already an IODE Associate Data Unit as well as a Regional Training Centre under UNESCO-IOC's OceanTeacher Global Academy. This institute is a premier centre of excellence in Malaysia that focuses its activities on oceanic and marine related research and post-graduate training. INOS will support the OBIS activities in the Asian region and will organize an OBIS training course for Asian OBIS nodes and candidate OBIS nodes in October 2017.

146 The Permanent Commission for the South Pacific (CPPS) has become an IODE Associate Data Unit and joined OBIS as a new OBIS node. CPPS is an intergovernmental body created in 1952. This Regional Maritime Organization promotes and articulates the cooperation and coordination of the maritime policies of its Member States: Chile, Colombia, Ecuador and Peru. CPPS administrates two online information systems: the Information System on Marine Biodiversity and Protected Areas (SIBIMAP) and the geoportal of the Southeast Pacific Data and Information Network to Support the Integrated Coastal Area Management Project (SPINCAM). One of the CPPS objectives is become a knowledge node in the region and provide a permanent platform to integrate data from different projects and programmes carried out in the region.

147 In December 2016, the Biology and Ecosystems Panel of the Global Ocean Observing System (GOOS BioEco), the Marine Biodiversity Observation Network (MBON) of the Group on Earth Observations Biodiversity Observation Network (GEOBON), and OBIS signed a collaboration agreement to build a sustained, coordinated, global ocean system of marine biological and ecosystem observations by enhancing existing observation scope and capacity, identifying essential ocean variables, collecting the observations deemed necessary to best

assess ocean living resources, implementing best practices and international standards, and enhancing global capacity to ensure continuity of global marine biological and ecosystem observations for the long term. OBIS continues to be an important information source for the identification of Ecologically or Biologically Significant Areas (EBSAs) of the Convention on Biological Diversity (CBD).

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

148 During the 2016-17 intersessional period, UNDP's Ocean Governance programme continued implementation and development of a broad portfolio of ocean projects including management of Large Marine Ecosystems, "greening" the shipping industry, integrated coastal management, sustainable fisheries, and support to SIDS in applying "ridge to reef" integrated natural resources management approaches.

149 UNDP/GEF ocean projects under implementation included the Caribbean Sea and N. Brazil Shelf LMEs project (CLME+; <http://www.clmeproject.org>); GloBallast Partnerships (with IMO, completed its 17 year operational period in June 2017, <http://globallast.imo.org>); PEMSEA (www.pemsea.org); Pacific SIDS Ridge-to-Reef programme (www.pacific-r2r.org); Global Marine Commodities Project; Coastal Fisheries Initiative (LAC Component, www.fao.org/in-action/coastal-fisheries-initiative/en/); Pacific Oceanic Fisheries Management 2 (with FAO, FFA and SPC, www.ffa.int/node/1732); Global Maritime Energy Efficiency Project (GloMEEP, with IMO, <http://glomeep.imo.org>); LME:LEARN (with IOC/UNESCO); Yellow Sea Large Marine Ecosystem project (<http://yslme.iwlearn.org>).

150 In addition, over the last 12 months, UNDP secured approval for GEF financing of four new ocean and coastal projects of relevance to the work of GESAMP; these include:

- Reducing Pollution and Preserving Environmental Flows in the East Asian Seas through the Implementation of Integrated River Basin Management in ASEAN Countries (in cooperation with ASEAN and PEMSEA);
- Building Partnerships to Assist Developing Countries Minimize the Impacts from Biofouling - GloFouling Partnerships (in cooperation with IMO); Strengthening capacity for international cooperation in the ecosystem-based management of the Antarctic Large Marine Ecosystem (in cooperation with CCAMLR); and
- Catalysing implementation of a Strategic Action Programme for the Sustainable Management of Shared Living Marine Resources in the Humboldt Current System (HCS).

151 UNDP also participated in and contributed to a number of global ocean conferences and related meetings and symposia, including the Ocean Conference (5-9 June 2017); UN High Level Political

Forum (oceans/SDG14 side events); 2016 & 2017 Stockholm World Water Week (SDG6/14 Source-to-Sea sessions); Large Marine Ecosystems Conference (5-9 December 2016); ocean lectures to Int'l Ocean Institute Master's programme (Malta, December 2016). Linked to the June Ocean Conference, in 2017 UNDP launched a series of ocean publications:

- [Sea, My Life](#) (UNDP/GEF Biodiversity & International Waters);
- [The Large Marine Ecosystem Approach: An Engine for Achieving SDG14](#) (UNDP/GEF, IOC/UNESCO, LME:LEARN);
- [Large Marine Ecosystems & Sustainable Development: A Review of Strategic Management Processes and Goals](#) (UNDP/GEF);
- [The GloBallast Story: Reflections from a Global Family](#) (GEF/UNDP/IMO GloBallast programme); and
- [Making Waves: Community Solutions, Sustainable Oceans](#) (GEF/SGP, Equator Initiative).

152 In support of the Ocean Conference, UNDP also launched and managed the Ocean Action Hub (www.oceanactionhub.org) which remains in place as a platform to promote networking, news/info, sharing of best practice and partnership building in support of SDG14 and the Ocean Conference Voluntary Commitments.

FOOD AND AGRICULTURE ORGANIZATION (FAO)

FAO study on "Microplastics in fisheries and aquaculture: occurrence and impacts"

153 With the support from UNEP, and, in particular with Norwegian funding, FAO carried out an assessment study on "Microplastics in fisheries and aquaculture: occurrence and impacts".

154 The preparation of a draft review document was commissioned. The resulting draft review document was then shared with a range of international experts in the fields of ecology of marine microplastics pollution, fisheries and aquaculture, and seafood safety risk assessment, modelling and management. A technical workshop was convened in December 2016 in Rome with a range of selected invited experts who discussed and worked on the review document. A number of attending experts had also contributed to GESAMP Working Group 40 on microplastics, and Dr Peter Kershaw kindly agreed to chair the workshop in Rome.

155 The experts also assessed the potential impact of microplastics and related contaminants on fish consumers' health and the consequences on fish productivity. The results show no evidence that microplastics' ingestion has negative effects on wild or farmed aquatic organisms. While humans can be exposed to microplastics through fish consumption, current scientific evidence shows that the effect is

negligible for the largest microplastics. It is thought that the risk associated with the consumption of fishery and aquaculture products contaminated with microplastics is negligible and their benefits are known to be numerous.

156 However, the report highlights some knowledge gaps, in particular regarding smaller sized microplastics and nanoplastics. Eventual risks linked to nanoplastics are likely to be higher than for microplastics. Nonetheless, measures should be taken at international, governmental and consumer levels to undertake cost-effective seafood safety risk assessments on micro- and nanoplastics and associated polymers, to reduce plastic use and encourage the use of alternative materials, recycling and the adoption of sustainable practices in using plastics and managing plastic pollution.

157 Following several review efforts and revisions the document “Microplastics in fisheries and aquaculture: occurrence and impacts” is being published as a FAO Fisheries and Aquaculture Technical Paper.

158 Clearly, this initiative has benefited significantly from previous efforts by GESAMP WG 40. FAO is grateful to GESAMP, its Chairperson and to GESAMP WG 40, as well as to all partner agencies for their interest and support in this initiative.

WORLD METEOROLOGICAL ORGANIZATION (WMO)

159 WMO is the authoritative voice on the state and behaviour of the Earth’s atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. WMO contributes to ocean-related issues through the observation and monitoring of the ocean, the climate and the composition of the atmosphere; research on the climate and Earth systems; development and delivery of services for disaster risk reduction, including marine hazards; and provision of science-based information and tools for ecosystem effects assessments, policymakers and the general public at regional and global levels.

Marine observations and applications

160 WMO continues to strengthen the global observing systems through implementation of the WMO Integrated Global Observing System (WIGOS) and WMO Information System (WIS), and observing networks with partners. For instance, the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS) continues to improve its capabilities in climate- and ocean-related services, and recognizes the importance of coastal observations and links to products for societal benefits. WMO is also collaborating with partner organizations such as the IOC-UNESCO to further develop, optimize and maintain in complement to satellite observations and remote sensing technology, in situ marine meteorological and oceanographic (metocean) observing networks in support of applications such as weather forecasting and operational meteorology, monitoring, understanding and prediction of climate variability and climate change at various time scales, ocean forecasting and marine

services activities, the protection and sustainable development of the ocean and marine environment, and the efficient management of marine resources, including disaster risk reduction in coastal regions.

161 In face of evolving requirements and advances in observing technology, and in response to GCOS requirements in particular, the WMO and the IOC of UNESCO through the Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM) are revising observing network implementation targets and addressing the means to reach those targets in the most cost-effective way. WMO also continues its collaboration with IMO and IHO for coordinated and standardized metocean information, forecasts and warning services for safety of life and property at sea, improved marine environment and sustainable management of natural resources, with due focus on Polar Regions.

Climate science and the oceans

162 A significant body of oceanographic research of direct benefit for decision-making in climate related risks is spearheaded and coordinated by the WMO-IOC/UNESCO-ICSU co-sponsored World Climate Research Programme (WCRP). Through its scientific leadership to consolidate global and regional efforts to understand the dynamics, the interaction and the predictability of the coupled ocean-atmosphere system, significant improvement has been made in understanding climate variability and changes, as well as the benefit of society and the environment in which we live – such as predictive experiments for the future state of climate system and project how it will evolve under different emission scenarios.

163 Development of scientific methods for treatment of uncertainty in climate-related decision-making is one of key subjects of research conducted by WCRP; a WCRP Grand Science Challenge on “Regional Sea Level Change and Coastal Impacts”^f addresses the imperative need for integrated interdisciplinary approach to establish quantitative understanding of regional to local sea level variability, to foster the development of sea level predictions and projections that are of increasing benefit for coastal zone management. The Grand Challenge on “Carbon feedbacks in the Climate System”^g is investigating land and ocean biogeochemical cycles and feedbacks on CO₂ concentrations and climate in order to better understand sources and sinks.

Monitoring and mitigating climate change

164 The Global Atmosphere Watch (GAW) continues to assess the latest trends and atmospheric burdens of the most influential long-lived greenhouse gases (LLGHGs). Results are published in WMO/GAW Annual GHG Bulletins^h.

^f See <http://www.wcrp-climate.org/grand-challenges/gc-sea-level>

^g See <http://www.wcrp-climate.org/gc-carbon-feedbacks>

^h WMO Greenhouse Gas Bulletin No. 12 (November 2016) Available at <http://www.wmo.int/pages/prog/arep/gaw/ghg/GHGbulletin.html>

165 In an effort to improve coordination of CO₂ observations between atmospheric and ocean communities, a special session on measurements of dissolved greenhouse gases and related ocean tracers was held at the 18th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2015), on 13–17 September, 2015 in La Jolla, California. Recommendations for QA/QC procedures and ocean observations are published as GAW report 229. The 19th GGMT, taking place on 27–31 August 2017 in Dübendorf, Switzerland, also included a session on ocean observations of GHGs.

166 At the 17th World Meteorological Congress, WMO adopted a resolution on the implementation of the Integrated Global Greenhouse Gas Information System (IG³IS)ⁱ with the aim to expand the observational capacity for GHGs, extend it to the regional and urban domain, and develop the information systems and modelling frameworks to provide information about GHG emissions to society. One of the objectives of IG³IS is to provide national and sub-national governments with timely and quantified information to support their assessment of progress towards their mitigation goals. This requires improved knowledge of the carbon cycle, including the ocean sink. The implementation of IG³IS fundamentally relies on the globally harmonized observations of GHGs, including in the oceans, and will require the development of high resolution and complex observing systems, modelling tools and data assimilation techniques.

167 WMO Members recognize the issues related to climate geoengineering and that further research is needed to adequately understand the potential feasibility, the effectiveness and risks associated with various techniques. As such, they have requested an assessment of the gaps in scientific understanding on climate engineering and appropriate research to address such gaps, and for it to be conducted in close cooperation with IMO, IOC/UNESCO, IPCC, WCRP and other relevant international, academic and science bodies. As an initial response to this, WMO is a supporting agency of GESAMP WG 41 on marine geoengineering, led by IMO and also with support from IOC/UNESCO, to carry out an assessment of a wide range of marine geoengineering approaches for their potential environmental and socio/economic impacts on the marine environment (and the atmosphere where appropriate) as well as their potential scientific practicality and efficacy for climate mitigation purposes. WMO hosted the WG's second workshop in Geneva, Switzerland, 26–27 April 2017.

168 During the Ocean Conference held in New York (5–9 June 2017), WMO's Secretary-General moderated a partnership dialogue on "Minimizing and addressing ocean acidification", co-chaired by Monaco and Mozambique. The dialogue highlighted several voluntary commitments by governments, the scientific

community, private sector, international finance institutions, and other stakeholders to strengthen existing partnerships and also address gaps in areas in which action is most needed. These include enhancing the knowledge on the science of ocean acidification; of its impacts on marine species and ecosystems, and its combined effect with sea warming, oxygen loss, pollution and other stressors; the knowledge of the socio-economic impacts of ocean acidification; and actions in the areas of mitigation, adaptation, protection and restoration.

Atmospheric composition information in support of marine ecosystem research and assessment

169 GAW is the only existing long-term international global programme that coordinates observations and analysis of atmospheric composition changes, with a view to help improve understanding of interactions between the atmosphere, the oceans and the biosphere. The GAW Implementation Plan for 2016–2023 places an increased emphasis on the delivery of value-added and cross-cutting products and services that are relevant to society, including climate, weather forecasting, ecosystem sustainability, human health, megacity development, agricultural productivity and many more.

170 WMO/GAW has been a long-time sponsor of GESAMP's Working Group on The Atmospheric Input of Chemicals to the Ocean (WG 38). WG 38 has published numerous studies related to the impact of atmospheric deposition of anthropogenic nitrogen to the ocean. WG 38 is now focusing on two new activities approved by GESAMP at its 42nd session: (1) an investigation of the changing atmospheric acidity and the oceanic solubility of nutrients; and (2) an investigation of the impact of ocean acidification on fluxes of non-CO₂ climate-active species. The WG developed a list of review papers to be completed on these topics at two simultaneous workshops held at the University of East Anglia, UK, 27 February to 2 March, 2017. See the report from the Co-Chairperson of Working Group 38 submitted to GESAMP 44 for details.

171 One of GAW's cross-cutting activities is the production of global maps of total atmospheric deposition, aerosols and gases for a number of atmospheric chemicals of importance for aquatic (freshwater and marine) and terrestrial ecosystems and human health (e.g. sulphur, ozone, nitrogen and other nutrients) through the application of the emerging technique of measurement-model fusion. A workshop was held at the WMO Headquarters, Geneva, Switzerland on 28 February to 2 March, 2017 to review existing knowledge and information and to develop a project plan. One of the speakers at the workshop was Prof. Timothy Jickells, Co-Chairperson of GESAMP WG 38, who provided an overview of observation- and model-based estimates of atmospheric inputs to the oceans. A summary of the workshop and a recommended path forward to develop global maps of total atmospheric deposition (starting with sulfur, nitrogen, and ozone) are published on GAW Report No. 234^j

ⁱ WMO, 2016. "Integrated Global Greenhouse Gas Information System (IG³IS)".
<http://www.wmo.int/pages/prog/arep/gaw/ghg/IG3IS-info.html>

^j http://www.wmo.int/pages/prog/gaw/documents/FINAL_GAW_234_23_May.pdf

172 WMO also collaborates with the marine research community through the Surface Ocean-Lower Atmosphere Study (SOLAS). WCRP has been a long-term sponsor of SOLAS. Scientists from the SOLAS community are also engaged in the work of GESAMP Working Groups 38 and 41. WMO/GAW participated in a SOLAS Science and Society workshop in Brussels, Belgium on October 26 and 27, 2016 that brought together researchers in the field of ocean-atmosphere interactions and social scientists with the goal to explore the following topics: (1) Valuing carbon and the ocean's role; (2) (In) Forming policy across the air-sea interface; and (3) The shipping industry and air-sea interactions. Since then, WMO attended a follow-up workshop at the American University in Rome (14-15 June 2017) to further advance the preparation of a review paper on Informing policy across the air-sea interface and a second one on Stewardship in the open ocean.

Prediction and monitoring on shorter time scales

173 The Polar Prediction Project (PPP^k), a joint initiative of WWRP and WCRP aims on improving predictability and services in polar regions, including predictions for sea ice. Besides providing guidance on optimizing polar observing systems, it focuses on improving the representation of key processes of the polar atmosphere, land, ocean and cryosphere and their interactions in numerical models. The Year of Polar Prediction (YOPP, mid 2017- mid 2019) is one of the key initiatives of PPP and will cover an extended period of coordinated intensive observational and modelling activities in order to improve polar prediction capabilities on a wide range of time scales in both polar regions. A specific dedicated effort in improving sea-ice observations over the Arctic Ocean is a key highlight for 2017.

DIVISION FOR OCEAN AFFAIRS AND THE LAW OF THE SEA (DOALOS), OFFICE OF LEGAL AFFAIRS

Introduction

174 Among its core functions, the Division for Ocean Affairs and the Law of the Sea (DOALOS), Office of Legal Affairs, United Nations, carries out the responsibilities entrusted to the Secretary-General under the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and the 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (United Nations Fish Stocks Agreement), and as provided by the General Assembly through its annual resolutions on oceans and the law of the sea and on sustainable fisheries. This section is intended to highlight relevant information on developments related to oceans and the law of the sea issues since October 2016.

^k See <http://www.polarprediction.net>

Informal Consultative Process

175 The United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (the Informal Consultative Process) held its eighteenth meeting from 15 to 19 May 2017 and, pursuant to General Assembly resolution 71/257, focused its discussions on the topic entitled "The effects of climate change on oceans". As in the past, the meeting was organized around panel presentations by experts representing developed and developing countries and reflecting various perspectives and disciplines, followed by interactive discussions.

176 Prior to the eighteenth meeting of the Informal Consultative Process, the report of the Secretary-General on oceans and the law of the sea was prepared, with a view to facilitating discussions on the topics of focus at that meeting (A/72/70). In particular, the report refers to the work of GESAMP on the topic of focus of the meeting.

177 Pursuant to General Assembly resolution 71/257, the Informal Consultative Process at its nineteenth meeting to be held in 2018 will focus its discussions on the theme "Anthropogenic underwater noise".

Conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction

178 The Preparatory Committee established by resolution 69/292: Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction held its third and fourth sessions from 27 March to 7 April and from 10 to 21 July 2017, respectively. On 21 July 2017, at the end of the fourth session, the Preparatory Committee adopted, by consensus, its recommendations to the General Assembly, which contain non-exclusive elements of a draft text of an international legally binding instrument under UNCLOS that generated convergence among most delegations (Section A) and some of the main issues on which there is divergence of views (Section B).^l Furthermore, the Preparatory Committee recommended to the General Assembly to take a decision, as soon as possible, on the convening of an intergovernmental conference, under the auspices of the United Nations, to consider the recommendations of the Preparatory Committee on the elements and to elaborate the text of an international legally binding instrument under UNCLOS (para. 2). The recommendations are contained in the Report of the Preparatory Committee established by General Assembly resolution 69/292: Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.^m

^l Sections A and B do not reflect consensus (para. 1).

^m The Advance, unedited version of the report is currently available at:

http://www.un.org/Depts/los/biodiversity/prepcom_files/Procedural_report_of_BBNJ_PrepCom.pdf

179 Pursuant to its resolution 69/292, the General Assembly is scheduled, before the end of its seventy-second session, and taking into account the aforementioned report of the preparatory committee, to decide on the convening and on the starting date of an intergovernmental conference, under the auspices of the United Nations, to consider the recommendations of the preparatory committee on the elements and to elaborate the text of an international legally binding instrument under the Convention (para. 1(k)).

180 All documents of the Preparatory Committee are available at its website <http://www.un.org/Depts/los/biodiversity/prepcom.htm>, including the Chairpersons overviews of the first, second and third sessions, as well as the Chairpersons streamlined non-paper on elements of a draft text of an international legally-binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

The Regular Process for Global Reporting and Assessment of the State of Marine Environment, including Socioeconomic Aspects

181 The Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects (The Regular Process) aims to strengthen the science-policy interface by regularly and comprehensively reviewing the environmental and socioeconomic aspects of the world's oceans, both current and foreseeable. The publication of the output of the first cycle, the first Global Integrated Marine Assessment (World Ocean Assessment) was officially launched during the Ocean Conference in New York, on 5 June 2017. In its resolution 70/235, the General Assembly decided to launch the second cycle of the Regular Process.

182 Following the launch of the second cycle of the Regular Process (resolution, 70/235 of 23 December 2015), the General Assembly, in resolution 71/257, decided that the second cycle of the Regular Process will cover five years, from 2016 to 2020, and extended the scope of the second cycle from establishing a baseline to evaluating trends and identifying gaps. The resolution further decided that the Ad Hoc Working Group of the Whole on the Regular Process should facilitate the delivery of the outputs of the second cycle as outlined in the Programme of work for the period 2017-2020. The Programme of work, adopted at the seventh meeting of the Ad Hoc Working Group, envisages two key outputs: first, to deliver the second World Ocean Assessment in 2020 and second, to prepare assessments during the second cycle to support other ocean-related United Nations processes. Already, three Technical Abstracts have been produced, namely on the 2030 Agenda, the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, and the impacts of climate change and related changes in the atmosphere on the oceans. These technical abstracts streamline key information contained in the first World Ocean Assessment for policymakers, and are available at the website of the Regular Process http://www.un.org/depts/los/global_reporting/global_reporting.htm. Further information about the Regular

Process is also available from <http://www.worldoceanassessment.org/>

183 In accordance with the Programme of work for 2017-2020, a number of regional workshops are to be organized, the first round of which will be held this year. The workshops will assist in scoping regional priorities for the assessments of the second cycle, build capacity, and facilitate outreach and awareness-raising. The first workshop will be held in Lisbon, Portugal from 14-15 September 2017 and will cover the North Atlantic, the Baltic Sea, the Mediterranean Sea and the Black Sea. UNEP will be hosting the workshop for the Arabian Sea, the Red Sea, the Gulf of Aden and the ROPME/RECOFI Sea Area, while IOC-UNESCO will host the workshop for the North Pacific. Workshops will also be hosted for the South Pacific (New Zealand) and the South Atlantic and wider Caribbean (Brazil, 14-15 November 2017).

The Ocean Conference, including the World Oceans Day celebration

184 Pursuant to General Assembly resolutions 70/226 and 70/303, the United Nations Conference to Support the Implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development (The Ocean Conference) was held at United Nations Headquarters in New York from 5 to 9 June 2017. The programme of the Conference consisted of eight plenary meetings, seven Partnership Dialogues and a special event commemorating World Oceans Day on 8 June. Themes for the partnerships dialogues included the following: "Addressing marine pollution"; "Managing, protecting, conserving and restoring marine and coastal ecosystems"; "Minimizing and addressing ocean acidification"; "Increasing scientific knowledge and developing research capacity and transfer of marine technology". DOALOS was the lead focal point for the organization of the dialogue on "Enhancing the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS".

185 Over 150 side events also took place during the period of the Conference.

186 The Conference adopted, by consensus, the intergovernmentally agreed declaration "Our ocean, our future: call for action" to support the implementation of Sustainable Development Goal 14. The report of the Conference also contains the Co-Chairpersons summaries of the Partnership Dialogues, as well as a list of 1380 voluntary commitments and partnerships registered within the context of the Conference for the implementation of Goal 14.

187 The advance, unedited version of the report of the Conference, together with other documents related to the Conference, is available at: <https://oceanconference.un.org/>

Sustainable fisheries

188 Pursuant to resolutions 69/109 and 70/75, the General Assembly conducted a further review of the actions taken by States and regional fisheries management organizations and arrangements

(RFMO/As) in response to paragraphs 113, 117 and 119 to 124 of resolution 64/72 and paragraphs 121, 126, 129, 130 and 132 to 134 of resolution 66/68 on sustainable fisheries, addressing the impacts of bottom fishing on vulnerable marine ecosystems and the long-term sustainability of deep-sea fish stocks, with a view to ensuring effective implementation of the measures therein and to make further recommendations, where necessary, in the context of the informal consultations of the General Assembly on the draft resolution on sustainable fisheries in November 2016.

189 In this regard, in its resolution 71/123, while the General Assembly welcomed the important progress made by States, RFMO/As and those States participating in negotiations to establish a regional fisheries management organization or arrangement competent to regulate bottom fisheries to implement paragraphs 80 and 83 to 87 of resolution 61/105, paragraphs 113, 117 and 119 to 124 of resolution 64/72 and paragraphs 121, 126, 129, 130 and 132 to 134 of resolution 66/68 and address the impacts of bottom fishing on vulnerable marine ecosystems, it noted with concern the uneven implementation of those provisions and that, in particular, bottom fishing continued to occur in certain areas beyond national jurisdiction without an impact assessment having been completed in the 10 years since the adoption of resolution 61/105 (para. 179). The General Assembly called upon, in this regard, States, RFMO/As with the competence to regulate deep-sea fisheries, and States participating in negotiations to establish such organizations or arrangements to take a number of urgent actions regarding bottom fishing in areas beyond national jurisdiction (para. 180; see also paras. 156, 181-191 and 219). The General Assembly decided to conduct in 2020 a further review of the actions taken by States and RFMO/As in response to paragraphs 113, 117 and 119 to 124 of resolution 64/72 and paragraphs 121, 126, 129, 130 and 132 to 134 of resolution 66/68 and paragraphs 156, 171, 175, 177 to 188 and 219 of resolution 71/123, with a view to ensuring effective implementation of the measures therein and to make further recommendations, where necessary, and decided to precede that review with a two-day workshop (para. 192).

190 Relevant resolutions, reports and other documents are available on the Division's website at: <http://www.un.org/Depts/los/index.htm>

UN ENVIRONMENT (United Nations Environment Programme-UNEP)

Marine and Coastal Strategy

191 The work on the marine and coastal ecosystems at UN ENVIRONMENT is conducted based on the marine and coastal strategy. The strategy covers four major areas: the land-ocean connection, ecosystem services, balancing use and conservation, and vulnerable people and places. The outcomes are achieved by scientific assessment, policy, planning and communications, providing objective science-based information and enhancing users' capacities. UN ENVIRONMENT work focuses on using sound science to apply ecosystem management to the factors that

cause decline of ecosystem services in marine and coastal areas.

192 UN ENVIRONMENT continues to provide technical support and capacity development for integrated management of marine and coastal ecosystems within the framework of its marine and coastal strategy. In particular, support is given to Member States through the platforms of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) and the Regional Seas programmes and action plans such as the Abidjan Convention, Barcelona Convention, Cartagena Convention, East Asian Seas Action Plan, Nairobi Convention, and Northwest Pacific Action Plan. There is also extensive collaboration with UN Agencies such as United Nations Educational Scientific and Cultural Organization- Intergovernmental Oceanographic Commission (UNESCO/IOC), United Nations Development Programme (UNDP), International Maritime Organization (IMO), United Nations Food and Agriculture Organization (FAO), United Nations Division for Ocean Affairs and the Law of the Sea (UN DOALOS), United Nations Department of Economic and Social Affairs (UN DESA), United Nations Human Settlements Programme (UN-Habitat) and the World Bank.

193 Through paragraph 17 of the resolution 2/10 Oceans and Seas of the Second Session of the United Nations Environment Assembly (UNEA), Member States requested the Executive Director of UN ENVIRONMENT to assess the effectiveness of the current marine and coastal strategy. Based on the assessment, UN ENVIRONMENT will submit a proposal for its updates, revision or replacement to the Third Session of the Environment Assembly to be held in December 2017.

Regional Seas Programmeⁿ

194 UN ENVIRONMENT has been coordinating the UN ENVIRONMENT Regional Seas Programme since 1974. The Regional Seas programmes are among the most important regional mechanisms for the conservation and sustainable use of the marine and coastal environment. There are currently eighteen Regional Seas programmes around the world and more than 143 countries participate in the programmes. UN ENVIRONMENT currently administers seven Regional Seas programmes^o.

195 Member States have reiterated the importance of the UN ENVIRONMENT Regional Seas Programme for the sustainable management of the oceans through the resolution 2/10 Oceans and Seas of the Second Session of the United Nations Environment Assembly. The contributions of the Regional Seas programmes in assisting Member States with implementing the ocean-related Sustainable Development Goals (SDGs) were stressed. The 18 Regional Seas meeting held in October 2017 in Korea emphasized the need for

ⁿ <http://www.unep.org/regionalseas/>

^o Abidjan Convention, Barcelona Convention, Cartagena Convention, East Asian Seas Action, Nairobi Convention, Plan, Northwest Pacific Action Plan, and Tehran Convention

regionally coordinated national actions and reporting for the sustainable development goals, particularly Goal 14.

Activities in the regions:

Nairobi Convention^P

196 On 25 November 2016 in Seychelles, the Nairobi Convention in partnership with WWF-Madagascar brought together civil society organizations working in the Northern Mozambique Channel to explore the options for partnerships and discussed the role of Northern Mozambique Channel as a good example of integrated ocean management approach for implementation of Sustainable Development Goal 14 on oceans and seas and the Agenda 2030 for sustainable development. The workshop also focused on the need for integrated management of ongoing and arising projects ensuring sustainable development with development approaches for oil and gas in the Northern Mozambique Channel.

197 The third round of negotiations on the Nairobi Convention Protocol on Integrated Coastal Zone Management (ICZM) was held on 21-26 November 2016 in Zanzibar to address outstanding issues of the Protocol and explored possible options for the effective management of marine and coastal environment in the Western Indian Ocean. The negotiations meeting was organized pursuant to Decision CP8/3 of the Eighth Conference of Parties to the Nairobi Convention urging Nairobi Convention to finalize all the key elements of the protocol for presentation to the ninth Conference of Parties.

198 The November 2016 Zanzibar meeting of experts in environmental management of the emerging oil and gas industry in the Western Indian Ocean region developed a regional oil and gas capacity building programme. The programme aims to establish and strengthen capacity in oil and gas regulatory frameworks and support the Contracting Parties to the Nairobi Convention and manage oil and gas development in accordance with the universal standards and best practices. As a follow-up, the Nairobi Convention in collaboration with the Government of Norway will hold a regional workshop on managing environmental emergencies in the oil and gas industry in the Western Indian Ocean in October 2017. The workshop will lay the groundwork on environmental management for oil and gas development necessary to generate policy, business and civil society actions towards the sustainable management of the oil and gas resources in the region.

199 As a follow up to Nairobi Convention Contracting Parties Decision CP8/10 on Blue/Ocean economy in which Contracting Parties were urged to apply blue or ocean economy approaches as pathways for sustained economic growth, food security, poverty eradication, job creation and environmental sustainability, WWF-Madagascar in January 2017 launched a report on 'Reviving the Western Indian Ocean Economy: Actions for a Sustainable Future'. The report offers estimates of the economic value

generated from the sea to motivate governments and economic sectors in the Western Indian Ocean to embark on a development pathway based on protecting the assets that deliver this economic value. The report aims to help Western Indian Ocean countries to achieve the SDG plan of action for 2016-2030 in the ocean sector and thus to realize the vision expressed under the regional strategic action programme, of "people prospering from a healthy Western Indian Ocean". <https://sustainabledevelopment.un.org/content/documents/13692WWF2.pdf>

200 In April 2017 the Nairobi Convention in partnership with the Wildlife Conservation Society reviewed the Regional Status Report on Sharks and Rays in the Western Indian Ocean for submission to the ninth Conference of Parties to the Convention in March 2018. The report aims to present major issues and gaps in knowledge, governance, capacities; and actions of priority for closing these gaps in the form of a regional roadmap for shark and ray conservation and management.

201 The Nairobi Convention participated in the second international conference on Marine Spatial Planning (MSP) of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in March 2017 in Paris, France. Among others, the conference identified the MSP priorities over the next decade (2017-2027), including applying MSP in Areas beyond National Jurisdiction. Nairobi Convention attended the Conference pursuant to the Eight Conference of Parties Decision CP8/13 requesting the Secretariat to collaborate with partners on capacity building, implementation, and sharing of experiences on integrated marine spatial planning in support of blue economy. As a follow up the Nairobi Convention Secretariat in collaboration with WIOMSA and Blue Climate Solutions and IOC-UNESCO will be organizing a regional training on Marine Spatial Planning in Western Indian Ocean region in November 2017 to build the capacity of the Contracting Parties to Nairobi Convention in marine spatial planning, methods and practices for an integrated and holistic approach to the management of coastal and marine resources in the region.

202 In April 2017 an outlook on 'Marine Spatial Planning of the Western Indian Ocean Blue Economy' was prepared by the Nairobi Convention to demonstrate ecosystem-based marine spatial planning as an effective tool for the implementation of the Western Indian Ocean Blue Economy by the Contracting Parties to the Convention. The report elaborates on the strong relationship between the Blue Economy and marine spatial planning (MSP), as well as proposing its place amongst other policy tools such as integrated coastal management (ICM), and presents regional progress on the uptake and use of MSP including in areas beyond national jurisdiction.

203 Countries of the Western Indian Ocean (WIO) region jointly developed a set of regional Voluntary Commitments, supported by a joint statement, which were presented at the UN Ocean Conference on SDG14 (New York, June 2017). These joint commitments were submitted within the framework of

^P <http://www.unep.org/nairobiconvention>

the Nairobi Convention, and consolidated during a Regional SDG14 Conference hosted by the Government of Seychelles in May 2017. Among the key commitments agreed upon by countries as part of this process are to strengthen ocean governance in the region, and to ensure the sustainable management of shared fish resources and collaborative management of marine and coastal resources in the Northern Mozambique Channel. Others included implementation of the strategic action programme to reduce impacts from land-based sources and activities and sustainably manage critical coastal and marine ecosystems through implementation of the agreed priorities and implementation of the Western Indian Ocean strategic action programme on policy harmonization and institutional reforms towards improved ocean governance and transition to a low carbon pathway. A follow-up action in October 2017 will bring together countries from the WIO region, in particular those with a specific interest in the Northern Mozambique Channel (NMC) area where WWF-Madagascar is active. The workshop will provide a forum to take stock of the outcomes of the UN Ocean Conference, and to expand the dialogue between countries and key stakeholder groups around their plans and commitments towards delivering on these commitments, as well as the SDG14 targets.

204 To enhance cooperation, collaboration and support with partners, Nairobi Convention participated in the International Maritime Organization subregional workshop on Particularly Sensitive Sea Areas in April 2017. The workshop introduced the International Maritime Organization's Particularly Sensitive Sea Areas concept and the associated guidelines for identifying and designating a Particularly Sensitive Sea Areas (PSSA). The workshop provided participants with an overview of the mechanics of preparing a proposal for particularly sensitive sea areas and navigating the proposal through the International Maritime Organization, and implementation and compliance of a regional and national particularly sensitive sea area. The workshop flagged the need to raise awareness on PSSA and their vulnerability to damage from international shipping, and the type of associated protective measures for PSSAs.

205 The Nairobi Convention is providing support for development of the oceans governance strategy taking into account AIMS 2050 strategy, African Union Agenda 2063, and the Sustainable Development Agenda 2030. The gap analysis also takes into account the Charter on Maritime Security, Safety and other existing frameworks and initiatives for discussion in a regional conference with options to develop an Africa ocean governance strategy. As a follow up to this process, the Nairobi Convention participated in the Sixteenth Ordinary Session of the African Ministerial Conference on Environment (AMCEN) on 15-18 June 2017 in Libreville, Gabon.

206 The Nairobi Convention Secretariat attended the Africa Marine Waste conference in July 2017 in South Africa. The conference provided a platform for delegates from the public and private sector in Africa and experts from Africa and other countries to discuss issues of marine waste, including data and research, capacity building, prosperity through the development of economic enterprises centred on waste

management, education and awareness and the role of the consumer, government, industry and municipalities. Participants discussed innovative solutions to waste that are applicable to Africa and explored opportunities to shape a brighter future for the human health, economies and environments of Africa.

207 As part of the 'Implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land-based sources and activities (WIOSAP) the Nairobi Convention in collaboration with WIOMSA organized a scoping workshop in June 2017 to review the status and outlooks of marine protected areas and critical habitats in the Western Indian Ocean region in line with Agenda 2030 for Sustainable Development Goal 14 targets 14.2 and 14.5. The review process aims at assisting Contracting Parties achieve their obligations under SDG14 on oceans and the Convention of Biological Diversity (CBD) Aichi Strategic Goal C, Target 11, to increase MPA coverage for coastal and marine protection in the region to 10% by 2020. To contribute to this Agenda and pursuant to Decision CP8/13 on enhancing cooperation, collaboration and support with partners, the Nairobi Convention had earlier participated in the workshop on Marine Genetic Resources Area based Management Tools in Marine Protected Areas in Areas Beyond National Jurisdiction on May, 2017 in Switzerland, and the Second Sustainable Ocean Initiative (SOI) Global Dialogue with Regional Seas Organizations and Regional Fisheries Bodies on Accelerating Progress towards the Aichi Biodiversity Targets held in Seoul, Korea, in June 2017.

208 The Nairobi Convention in collaboration with Kenya's National Environment Management Authority (NEMA) organized a three-day leadership training on the management of the coastal and marine environment in July 2017 in Mombasa to equip senior policy makers with skills for better advocacy on the use of integrated approaches to the management of the coastal and marine ecosystems within government, and in partnerships with regional and global stakeholders. The training also equipped the policy makers with skills necessary for the development of informed policies and decision-making for ocean management. The training was organized pursuant to Decision CP8/6c of the Eighth Conference of Parties to the Nairobi Convention on support and partnership for implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land based sources and activities. The governance training was part of the process of strengthening governance and awareness in the Western Indian Ocean, which is a key component of the strategic action programme.

209 The Nairobi Convention participated in the EAF-Nansen Programme Science Plan 2018-2021 meeting organized by the UN Food and Agriculture Organization in August 2017 in Mauritius necessary to strengthen the knowledge base for the sustainable management of fisheries in the face of increasing fishing pressure, climate variability and change, pollution and other anthropogenic stressors in the South West Indian Ocean region. The four-year science plan will identify priority areas for collaborative work between the Western Indian Ocean countries and the EAF-Nansen Programme in marine fishery and

environmental research, fisheries management and capacity development.

Northwest Pacific Action Plan (NOWPAP)⁹

210 NOWPAP activities are structured around six major thematic areas: regular assessments, integrated coastal and river basin management, pollution prevention and reduction, biodiversity conservation, climate change impacts, and information management. NOWPAP Regional Coordinating Unit and four Regional Activity Centres (RAC) continued to address marine and coastal environmental issues such the development of Ecological Quality Objectives (EQOs), prevention and reduction of pollution from harmful substances and marine litter, and strengthening regional cooperation to prepare and respond to oil and NHS spills among key priorities. NOWPAP experts are also implementing projects focusing on major threats to marine and coastal biodiversity: eutrophication, destruction of coastal habitats and introduction of alien invasive species. Other projects are related to sea grass and seaweed habitat mapping and assessment of the status of threatened and endangered marine and coastal species in the region. The Pilot assessment of the impacts of major threats to marine biodiversity in selected areas of the NOWPAP region will be published in August 2017. Case studies of seagrass and seaweed mapping in selected sea areas in the NOWPAP region using remote sensing will be published by the end of 2017.

211 In May 2016, NOWPAP focal points agreed on the list of EQOs common to the four NOWPAP countries, including: (1) Biological and habitat diversity have not changed significantly due to anthropogenic pressure; (2) Alien species are at levels that do not adversely alter the ecosystem; (3) Eutrophication adverse effects are absent; (4) Contaminants cause no significant impact on coastal and marine ecosystems and human health; and (5) Marine litter does not adversely affect coastal and marine environments. NOWPAP has prepared for the draft Regional overview of possible Ecological Quality Objective indicators for the NOWPAP region in July 2017. The indicators and targets for each EQO will become a basis for the next NOWPAP Medium Term Strategy 2018-2023.

212 The NOWPAP Regional Action Plan on Marine Litter is also being implemented in cooperation with central and local governments in the NOWPAP Member States as well as non-governmental organizations (NGOs) including the organization of highly successful International Coastal Clean-up campaigns in all participating countries. The review and analysis of existing prediction models for floating marine litter has been prepared in 2017. NOWPAP is a member of the Global Partnership on Waste Management (GPWM) and has been hosting the NW Pacific regional node of the Global Partnership on Marine Litter (GPML) since 2014.

213 NOWPAP continues developing and strengthening partnerships with the relevant organizations and programmes in the region, including North-East Asian Subregional Programme for

Environmental Corporation (NEASPEC), North Pacific Marine Science Organization (PICES), Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), and UNESCO/IOC Sub-Commission for the Western Pacific (WESTPAC), Yellow Sea Large Marine Ecosystem (YSLME) Phase II Project to name a few. NOWPAP contributes to the implementation of the Sustainable Development Strategy for the Seas of East Asia and provides technical expertise to the Convention on Biological Diversity on relevant issues such as description of ecologically or biologically significant marine areas (EBSAs) in the region.

214 NOWPAP Member States are currently developing a new Medium-term Strategy (MTS) for the period 2018-2023 and the implementation plan to tackle multiple regional challenges and ways to revitalize and expand the NOWPAP partnership. The draft Strategy intends to align future NOWPAP activities with the delivery of Sustainable Development Goals (SDGs). The proposed focus areas of the MTS include: supporting integrated coastal and river basin planning and management, assessing status of the marine and coastal environment, preventing and reducing land- and sea-based pollution and conserving marine and coastal biodiversity. The Strategy is expected to be adopted at the 22nd Intergovernmental Meeting in December 2017.

The Regular Process for reporting and assessment of the state of the marine environment including socioeconomic aspects.

215 World Oceans Assessment (WOA), with its secretariat (UN DOALOS) and Member States completed the implementation of first phase of assessment cycle 2010-2015 at the end of 2015. On 23 December 2015, the United Nations General Assembly adopted resolution 70/235 on "Oceans and the law of the sea," in which it welcomed with appreciation the first global integrated marine assessment^r and approved its summary.

216 The second phase of the WOA was launched in January 2016. UN Environment and other relevant United Nations system organizations, bodies, funds and programmes have been invited to assist in the implementation of the second cycle of the Regular Process with regard to the following activities: awareness-raising, identification of experts for the Pool of Experts, technical and scientific support to the Bureau and the Group of Experts, hosting workshops and meetings of the writing teams, capacity-building and the scoping process for the assessment(s) of the second cycle. While the first cycle of the Regular Process focused on establishing a baseline, it has been decided that the scope of the second cycle would extend to evaluating trends and identifying gaps. The second cycle will cover a period of five-years and two principal outputs have been proposed in the work plan. UN Environment is expected to provide scientific and technical support to the Group of Experts, the bureau and the secretariat.

⁹ <http://www.nowpap.org/>

^r http://www.un.org/Depts/los/global_reporting/WOA_RegProcess.htm

The GEF Transboundary Waters Assessment Programme (TWAP)

217 The TWAP Full Size Project which commenced in April 2013 and envisioned to fill two major objectives: (1) to undertake the first global assessment of transboundary water systems that will assist GEF and other international organizations improve the setting of priorities for funding; and (2) to formalise the partnership with key institutions so that transboundary considerations are incorporated in regular assessment programmes has been completed. It is currently undergoing a terminal evaluation.

218 The assessment results are organized into five technical reports and a sixth volume that provides a cross-category analysis of status and trends:

- Volume 1: Transboundary Aquifers and Groundwater Systems of Small Island Developing States: Status and Trends
- Volume 2: Transboundary Lakes and Reservoirs: Status and Trends
- Volume 3: Transboundary River Basins: Status and Trends
- Volume 4: Large Marine Ecosystems: Status and Trends
- Volume 5: The Open Ocean: Status and Trends
- Volume 6: Transboundary Water Systems: Crosscutting Status and Trends

219 A Summary for Policy Makers accompanies the first five volumes and A Global Compendium of Water System Information Sheets is an online accompaniment of the Crosscutting Analysis discussed in Volume 6. It has 12 annexes and organized into 14 TWAP regions, it compiles information sheets on 765 international water systems including the baseline values of quantitative indicators that were used to establish contemporary and relative risk levels at system and regional scales. All TWAP publications are available at www.geftwap.org. Other products include a TWAP Comparative Analysis of Governance Report and the Transboundary Water Profile-Global Baseline Folio. To provide access to the quantitative data that underpin the assessments, a central data portal can be explored at <http://www.geftwap.org/data-portal>. For water category-specific data and water-system factsheets, links to partner websites are also provided from the central data portal webpage.

220 The execution of the TWAP has been coordinated by UN ENVIRONMENT (Science Division as executing unit and the Ecosystem Division as implementing unit, project-wide) and involves many partners already engaged in assessment efforts. Lead organizations at the project component scale are: Transboundary aquifers and SIDS groundwater systems: UNESCO's International Hydrological Programme (IHP); Transboundary lake/reservoirs basins: International Lake Environment Committee (ILEC); Transboundary river basins: UN ENVIRONMENT-DHI Centre for Water and Environment (lead); Large marine ecosystems: Intergovernmental Oceanographic Commission of UNESCO (IOC of UNESCO); Open ocean: IOC of UNESCO; Crosscutting Analysis: UN ENVIRONMENT-Science Division; and Data and information

management: UN ENVIRONMENT/Science Division/Global Resources Information Database (GRID-Geneva).

Global Resources and Information Data Centre (GRID-Arendal)

221 GRID-Arendal, a centre collaborating with the UN ENVIRONMENT, supports informed decision-making and awareness-raising through: (a) Environmental information management and assessment; (b) Capacity building services; and (c) Outreach and communication tools, methodologies and products.

222 GRID-Arendal has been actively involved in building capacity in ecosystem-based marine management and enabling of sustainable blue economies in developing countries. Marine spatial planning, state of the environment reporting, sound management of the deep seabed, the ocean and climate change (e.g. blue carbon) and promoting and replicated demonstrated 'blue solutions' are some of the other areas of focus of marine and coastal activities for GRID-Arendal.

223 GRID-Arendal helped UN ENVIRONMENT draw up a global support programme for monitoring the state of the marine environment in the Regional Seas; this is now being tested in West Africa. Additionally a presentation of the method was recently given to the Caribbean countries in Kingston, Jamaica in a workshop organized by the UN ENVIRONMENT Caribbean Regional Coordinating Unit and Secretariat.

224 Having worked with UN ENVIRONMENT and key partners to produce a Vital Graphics on Marine Litter, work is now progressing to develop target awareness raising and capacity building efforts to mitigate and reverse the impacts of marine litter, plastics and microplastics on the ocean. Initial discussions with potential partners in Africa, with support from the Government of Norway and UN ENVIRONMENT, aims to produce a concrete action plan during 2017.

225 In partnership with UN ENVIRONMENT, GIZ and IUCN, GRID-Arendal has developed and implemented the Blue Solutions Initiative which provides a global platform to collate, share and generate knowledge and capacity for sustainable management and equitable governance of our ocean. Through different formats and cooperation with various Partner institutions Blue Solutions seeks to enhance capacities for scaling up success, provide learning opportunities and support policy processes to facilitate the putting into practice of viable and valuable solutions.

226 GRID-Arendal continued to support the Regional Seas Conventions and Action Plans and their Member States on a number of fronts. The Interim Secretariat of the Tehran Convention continues to be supported in its work to establish a fully functioning Secretariat. The first national State of the Marine Environment (SoME) report for Sierra Leone was completed using an Expert Elicitation participatory approach to properly integrate the observations of experts with concrete (although limited) data. The final

report was endorsed by the President of Sierra Leone. A synthesis report on “The Socioeconomics of the West, Central and Southern African Coastal Communities” will soon be published for the Abidjan Convention. Additionally, a “Blue Carbon Financing of Mangrove Conservation in the Abidjan Convention Region: A Feasibility Study” will help set the stage for more active work on enabling blue carbon approaches in the Abidjan Convention region.

227 As part of an ongoing formal partnership with the Secretariat of the Abidjan Convention, GRID-Arendal is the executing agent for a multi-year capacity enhancing ecosystem-based management programme for Abidjan Convention region. The Mami Wata project will be applied in the countries of the Abidjan Convention region, which covers 22 countries and a combined EEZ of approximately 4.8 million km² in size. It is funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (International Climate Initiative), and implemented by GRID-Arendal, the Abidjan Convention Secretariat and UN ENVIRONMENT.

228 Following the joint submission by 7 coastal countries in West African (Mauritania, Senegal, The Gambia, Guinea, Guinea-Bissau, Cabo Verde and Sierra Leone) to the UN Commission on the Limits of the Continental Shelf (CLCS) in August 2015, GRID-Arendal, with support from the Government of Norway has committed to design and implement a process to maintain national expert capacity on continental shelf delineation while countries await their turn to present and discuss the joint submission with the CLCS. The first ‘capacity maintenance’ workshop took place in early 2017 in Cabo Verde.

229 Blue carbon initiative: The international GEF/UN ENVIRONMENT Blue Forests Project, executed by GRID-Arendal for UN ENVIRONMENT, is now in its second year of implementation. The effort is anchored by interventions and project work in five countries spanning five continents. The effort continues to detail and demonstrate the methodologies required for carbon sequestered by key ocean habitats to be recognized under the UNFCCC and REDD+ protocols.

230 GRID-Arendal is executing the international IW/Learn GEF Project in partnership with UN Environment, UNESCO-IOC, Conservation International, The Global Water Partnership, The International Commission for the Protection of the Danube River, The International Union for the Conservation of Nature, The Nature Conservancy, The United Nations Economic Commission for Europe, The International Hydrological Programme of UNESCO, The United Nations Industrial Development Organization and The World Wildlife Fund.

231 GRID-Arendal is a partner in the international Areas Beyond National Jurisdiction (ABNJ) GEF Project, executed by the World Conservation Monitoring Commission (UN ENVIRONMENT/WCMC). This project aims to deliver improved capacity in the Nairobi Convention and CPPS Regional Seas to undertake area based planning in areas beyond national jurisdiction.

UN ENVIRONMENT-World Conservation Monitoring Centre (WCMC)

232 UNEP-WCMC is the specialist biodiversity assessment arm of UN ENVIRONMENT based in Cambridge, UK. The focus of Marine Programme of the UNEP-WCMC is to develop and share data, tools, and analyses to inform decisions regarding the conservation of marine and coastal biodiversity. During the period under review, the Programme focused on four main areas: Improving and enhancing data, the effective use of data through analysis and interpretation, supporting marine spatial planning for improved conservation and resource use, and the application of area-based planning techniques in areas beyond national jurisdiction.

233 UNEP-WCMC has continued to enhance the Ocean Data Viewer (<http://wcmc.io/ODV>), which is an online portal that provides easy and free access to a range of marine biodiversity-related datasets drawn from internationally-respected scientific institutions and organizations. The quality of datasets has been improved with detailed metadata and background information that accompany them. UNEP-WCMC’s ‘Manual on marine and coastal datasets of biodiversity importance’ (<http://wcmc.io/MarineDataManual>), which is an inventory of 128 online marine and coastal data resources, was updated.

234 UNEP-WCMC is the executing agency for Component 4 of the FAO/UNEP GEF Project entitled ‘Sustainable fisheries management and biodiversity conservation of deep-sea living resources and ecosystems in Areas Beyond National Jurisdiction’ (known as the ABNJ Deep Seas Project). In this project and in collaboration with the Regional Seas Convention secretariats, management authorities and technical partners (including Seascope Consultants, Duke University, GRID Arendal, and NCEAS), UNEP-WCMC is developing and testing a methodology for area-based planning in the Western Indian Ocean and the South East Pacific. Contributing to this objective, UNEP-WCMC has published a report entitled ‘Governance of areas beyond national jurisdiction for biodiversity conservation and sustainable use’ which is focused on the Western Indian Ocean and South-East Pacific. The report identifies opportunities for enhanced collaboration between bodies with a governance role in ABNJ. As part of the same project, inventories of global data of biodiversity importance in ABNJ have been produced, and two regional workshops were held to explore area-based planning concepts and assess regional capacity.

235 UNEP-WCMC built upon the pre-existing UN ENVIRONMENT ‘marine spatial planning in practice database’ to develop an inventory of marine spatial examples from which cross-border marine spatial practices could be evaluated. This was supplemented by a detailed review of marine spatial planning in the Southern Ocean and Coral Triangle. The resultant report was presented at the EC/UNESCO-IOC 2nd International Conference on Marine Spatial Planning and made available online via EC and UNEP-WCMC websites.

236 As part of a project to explore legal options for the conservation of biodiversity beyond national jurisdiction (BBNJ) UNEP-WCMC, in partnership with Cambridge Conservation Initiative, University of Cambridge, Birdlife International and IUCN, published a report entitled '[Biodiversity Beyond National Jurisdiction: Legal options for a new international agreement](#)'. This report explores a range of options through which the proposed BBNJ implementing agreement can accommodate changing uses and pressures. The results of the study were presented at the 3rd meeting of the Preparatory Committee established by General Assembly resolution 69/292: Development of an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

237 UNEP-WCMC contributed to discussions of the UN Ocean Conference in June 2017 in New York. This included co-organizing with UN ENVIRONMENT a side event focused on 'Sharing effective area-based planning practices for sustainable oceans' at which UNEP-WCMC, Italian Government and OECD provided expert contributions. UNEP-WCMC also submitted three voluntary commitments: Catalysing ocean literacy (#OceanAction21016); Supporting effective ocean governance (#OceanAction21004); and Promoting enhanced access and use of global marine biodiversity information (#OceanAction20776).

238 UNEP-WCMC is contributing to a H2020 project entitled 'Operating a Network of Integrated Observatory Systems in the Mediterranean Sea' (ODYSSEA). ODYSSEA aims to develop, operate and demonstrate an interoperable and cost-effective platform that fully integrates networks of observing and forecasting systems across the Mediterranean basin.

UN ENVIRONMENT's Mercury Programme

239 UNEA has charged UN ENVIRONMENT with updating its 2013 Global Mercury Assessment (GMA) within a period of 6 years, (i.e. for delivery no later than 2019). Work has been initiated to develop an updated GMA for 2018.

240 The Main focus of the assessment is to update the global emissions and releases inventory components (for the target year of 2015), especially for sectors of relevance for the Minamata Convention. The assessment will also be expanded with respect to quantification of releases and discharges of mercury to the aquatic environment, and include an overview of mercury levels in humans and biota. Developed inventory estimates will be compared with nationally reported emissions and releases estimates, including those being developed through ongoing Minamata Initial Assessments (MIAs), and information from the planned update of the "Summary of Supply, Trade and Demand, 2006".

241 This work will facilitate a dialogue regarding future improvement of emission and release estimates. Additional sections of the GMA 2018 will address mercury environmental fate and transport. Planned products will include the GMA 2018 policymakers summary report which will be about 50 pages and

include a 2-page executive summary. This report will reflect the content of a comprehensive technical background document to be prepared through collaboration between UN ENVIRONMENT and the Arctic Monitoring and Assessment Programme (AMAP). A draft of the technical background report for the GMA 2018 will be available for comments in summer/autumn 2017. The report will be revised considering the comments received, and the GMA 2018 summary report will be prepared for delivery to UNEA in 2019.

ANNEX V - Current working groups and their terms of reference

WG 1: Evaluation of the hazards of harmful substances carried by ships

Lead Agency:	IMO
Co-sponsors:	None
Chairperson:	Thomas Höfer (Germany)
Members:	Stéphane le Floch (France), Thomas Höfer (Germany), Wenxin Jiang (China), Richard Luit (Netherlands), Bette Meek (Canada), Michael Morrisette (United States), Haito Saito (Japan), Patricio H. Rodriguez (Chile)
Products:	Hazard profiles of new substances and correspondence with the industry. Maintenance and update of 900 GESAMP hazard profiles
Planning:	55 th session in 2018

Terms of Reference for WG 1:

The terms of reference of the GESAMP EHS Working Group, as given by GESAMP at its 6th session in Geneva (1974) (96) and amended at its 8th session in Rome (1976) (97) are:

“To examine and evaluate data and to provide such other advice as may be requested, particularly by IMO, for evaluating the environmental hazards of harmful substances carried by ships, in accordance with the rationale approved by GESAMP for this purpose”.

These terms of reference remain unchanged.

WG 34: Review of applications for “Active Substances” to be used in ballast water management systems

Lead Agency:	IMO
Co-sponsors:	None
Chairpersons:	Jan Linders (Netherlands) Vice-Chairperson: Annette Dock (Sweden)
Members:	Teresa Borges (Portugal), Barbara Werschkun (Germany), Sinichi Hanayama (Japan), Kitae Rhie (Republic of Korea), David J. D. Smith (United Kingdom) Gregory Ziegler (United States), Claude Rouleau (Canada) Flavio da Costa Fernandes (Brazil).
Consultants:	Annette Dock (dual function)
Product(s):	Evaluation of the risks to the environment, human health and the ships' crew from ballast water management systems Completion of the methodology in Reports & Studies following external and GESAMP peer review (draft by September 2017)
Planning:	Two meetings of the BWWG are planned prior to the 45th session of GESAMP: the 35th meeting of the BWWG is taking place from 8 to 10 November 2017 and the 36th meeting from 4 to 8 June 2018. The 37th meeting is also scheduled tentatively from 9 to 13 July 2018 subject to the number of applications received.

Terms of Reference for WG 34:

- 1 Consideration of development of necessary methodologies and information requirements in accordance with the “Procedure for approval of ballast water management systems that make use of Active Substances (G9)” (adopted by resolution MEPC 169(57)) for consideration by MEPC 65.
- 2 For Basic Approval, the Group should review the comprehensive proposal submitted by the Member of the Organization along with any additional data submitted as well as other relevant information available to the Group and report to the Organization.

In particular, the Group should undertake:

- .1 Scientific evaluation of the data set in the proposal for approval (see paragraphs 4.2, 6.1, 8.1.2.3, 8.1.2.4 of Procedure (G9));
 - .2 Scientific evaluation of the assessment report contained in the proposal for approval (see paragraph 4.3.1 of Procedure (G9));
 - .3 Scientific evaluation of the risks to the ship and personnel to include consideration of the storage, handling and application of the Active Substance (see paragraph 6.3 of Procedure (G9));
 - .4 Scientific evaluation of any further information submitted (see paragraph 8.1.2.6 of Procedure (G9));
 - .5 Scientific review of the risk characterization and analysis contained in the proposal for approval (see paragraph 5.3 of Procedure (G9));
 - .6 Scientific recommendations on whether the proposal has demonstrated a potential for unreasonable risk to the environment, human health, property or resources (see paragraph 8.1.2.8 of Procedure (G9)); and
 - .7 Preparation of a report addressing the above-mentioned aspects for consideration by MEPC (see paragraph 8.1.2.10 of Procedure (G9)).
- 3 For Final Approval, the Group should review the discharge testing (field) data and confirm that the residual toxicity of the discharge conforms to the evaluation undertaken for Basic Approval and that the previous evaluation of the risks to the ship and personnel including consideration of the storage, handling and application of the Active Substance remains valid. The evaluation will be reported to the MEPC (see paragraph 8.2 of Procedure (G9)).
- 4 The Group should keep confidential all data, the disclosure of which would undermine protection of the commercial interests of the applicant, including intellectual property.

WG 38: Atmospheric input of chemicals to the oceans

Lead Agency: WMO

Co-sponsors: IMO, US National Science Foundation, SCOR, SOLAS, University of East Anglia

Chairpersons: R. Duce (United States), T. Jickells (United Kingdom)

Members: Alex Baker (United Kingdom), Laurent Bopp (France), Peter Croot (Ireland), Robert A. Duce (United States), Marion Gehlen (France), Cecile Guieu (France), Frances Hopkins (United Kingdom), Akinori Ito (Japan), Tim Jickells (United Kingdom), Maria Kanakidou (Greece), Kitack Lee (Republic of Korea), Natalie Mahowald (United States), Athanasios (Thanos) Nenes (United States), Manmohan Sarin (India); Parvadhe Suntharalingam (United Kingdom)

Product(s): Preparation of a summary of the working groups' publications arising from the 'Atmospheric Deposition of Nitrogen and its Impact on Marine Biogeochemistry' workshop to be published in the GESAMP and Studies series (draft submitted in September 2017). Also 6 papers published in the peer-reviewed scientific literature and one additional paper to be submitted by the end of 2017 on the nitrogen work.

Preparation of 12 peer-reviewed papers currently underway resulting from the recent WG 38 workshops "*Impact of Ocean Acidification on Fluxes of non-CO₂ Climate-Active Species*" and "*Changing Atmospheric Acidity and the Oceanic Solubility of Nutrients*".

Terms of Reference for WG 38:

Impact of Ocean Acidification on Fluxes of non-CO₂ Climate-Active Species

- 1 Review and synthesize the current science on the direct impacts of ocean acidification on marine production and emissions to the atmosphere of key species (apart from CO₂) important for climate and atmospheric chemistry.
- 2 Identify the primary needs for new research to improve process understanding and to quantify the impact of ocean acidification on these marine fluxes (i.e. provide recommendations on the specific laboratory process studies, field measurements and model analyses needed to support targeted research activities and improved understanding on this topic).
- 3 Publish the results of this activity in the open peer-reviewed scientific literature.
- 4 Provide input to and interact with national and international research programmes on ocean acidification (e.g. UKOA, NOAA-OAP) and with relevant WMO programmes (e.g. Global Atmosphere Watch (GAW)) to build on their recent relevant activity in achieving the above objectives.

Changing Atmospheric Acidity and the Oceanic Solubility of Nutrients

- 1 Review and synthesize the current scientific information on the solubility of aerosol associated key biogeochemical elements, the biogeochemical controls on aerosol solubility, and the pH sensitivity of those controls.
- 2 Consider the likely changes in solubility of key species into the future and the potential biogeochemical consequences of such changes.
- 3 Identify the key future research needs to reduce uncertainties in predictive capability in this area.
- 4 Publish the results of this activity in the open peer-reviewed scientific literature.
- 5 Interact with, and provide information to, leading relevant international groups including the Future Earth core projects SOLAS, IGAC and IMBER; SCOR, particularly its GEOTRACES programme; and WMO programmes such as GAW.

WG 39: Global trends in pollution of coastal ecosystems: retrospective ecosystem assessment

Lead Agency: IAEA

Co-sponsors: UNIDO

Chairpersons: Ana Carolina Ruiz-Fernandez (Mexico)

Members: Ms Roberta Delfanti (Italy), Mr José Marcus Godoy (Brazil), Mr Elvis Nyarko (Ghana), Mr Joan-Albert Sanchez-Cabeza (Mexico), Mr José L. Sericano (United States), Ms Elvira Sombrito (Philippines), Mr Norbert Theobald (Germany)

Product(s): Complete the analysis of the data and complete a final draft final report for review by internal and external reviewers in the latter part of 2018.

Terms of Reference for WG 39:

- 1 Bibliographic Review, definitions, methodologies.
- 2 Critical review of existing methodologies on suitable environmental archives, dating methods, pollution indicators, analytical techniques and trend analysis. Review existing data, including data quality.
- 3 Database of global trends of pollution.
- 4 Global assessment and evaluation of global trends of pollution.
- 5 Dissemination activities: Website, press releases, preparation of educational materials, presentation at stakeholder meetings.

WG 40: Sources, fate and effects of plastics and micro-plastics in the marine environment

Lead Agencies: UNESCO-IOC and UN Environment

Co-sponsors: IMO, FAO, NOAA, NOWPAP, Ministry of Environment Japan, State Ocean Administration China, EU-BASECAMP project

Co-Chairpersons: Peter Kershaw (United Kingdom), Alexander Turra (Brazil), Francois Galgani (France)

Members: Markus Eriksen (United States), Amy Lusher (Norway), Denise Hardesty (Australia), Martin Hasselov (Sweden), Sang Hee Hong (Republic of Korea), Sheri Mason (United States), Chelsea Rochman (Canada), Peter Ryan (South Africa), Shige Takada (Japan), Akbar Tahir (Indonesia), Martin Thiel (Chile), Chris Wilcox (Australia), Weiwei Zhang (China)

Product(s): Report covering ToR 1 '*Monitoring and assessment of marine plastics and microplastics: supporting a harmonised approach*'. Draft to be presented at GESAMP 45 with publication envisaged in late 2018, as a joint GESAMP, IOC and UN Environment publication.

Planning: The first full workshop of the third phase took place 11-14 September 2017 in Paris, hosted by IOC-UNESCO. Eleven members attended with additional Observers from NOAA and the German Fisheries Ministry. The IMO-administered Basecamp site is being used to collate background

information, including sampling and monitoring methods and protocols, and will be used to develop the report. The second full workshop is planned for June 2018 to finalize the report. The 6th International Marine Debris Conference (6IMDC) is taking place in March 2018, in San Diego USA. This will provide an opportunity to hold a side-event for the wider community to be made aware of WG40's progress and plans and provide feed-back of the proposed approach. A one-day closed meeting will be held at the conclusion of the main conference, for those WG members able to attend. Engagement with relevant UN agencies, Regional Seas organizations and other regional and national organizations and initiatives is regarded as critical for the delivery of a relevant and useful product (ToR1).

Work on producing a separate report covering ToRs 2 and 3 will depend on securing additional funding, and is not expected to be pursued actively until after the methods report has been finalized.

Terms of reference for WG 40:

- 1 To develop guidelines covering terminology and methodologies for the sampling and analysis of marine macro-plastics and microplastics, including:
 - .1 Size and shape definitions of particles.
 - .2 Sampling protocols for the whole spectrum of particle/object sizes in surface and sub-surface seawater, seabed sediments, shorelines and biota.
 - .3 Methodologies for physical and chemical identification and analysis of polymers and associated chemicals.
 - .4 Requirements for monitoring and assessment.
- 2 To assess the occurrence and effects of nano-sized plastics on marine organisms, and make research and policy-relevant recommendations.
- 3 To assess the significance of plastics and microplastics as a vector for indigenous and non-indigenous organisms, and make research and policy-relevant recommendations.

WG 41: Marine Geoengineering

Lead Agency: IMO

Co-sponsors: UNESCO-IOC and WMO

Chairpersons: Chris Vivian (United Kingdom), Philip Boyd (Australia)

Members: Richard Lampitt (United Kingdom), Andreas Oschlies (Germany), Greg Rau (United States), Alex Baker (United Kingdom), Katherine Ricke (United States), Fei Chai (United States), Ros Rickaby (United Kingdom), Timo Goeschl (Germany), John Cullen (Canada), Miranda Boettcher (Australia)

Product(s): Report on first phase of ToR will provide an overview to GESAMP Agencies and their Member States of a wide range of proposed marine geoengineering techniques and their potential implications and based on published literature. Final report of both phases including the detailed review of marine geoengineering techniques is due by end January 2018. The report will be made available on the website. It may include some outreach material as well.

Planning: The full report will be completed the first quarter of 2018 and will be discussed at the next annual session of GESAMP.

Terms of Reference for WG 41:

The GESAMP study should provide an overview to GESAMP Agencies and their Member States of a wide range proposed marine geoengineering techniques and their potential implications by:

1. Providing an initial high level review of a wide range of proposed marine geoengineering techniques, based on published information, addressing:
 - .1 The main rationale, principle and justification of the techniques.
 - .2 Their potential scientific practicality and efficacy for climate mitigation purposes.
 - .3 The potential impacts of different marine geoengineering approaches on the marine environment and the atmosphere where appropriate.
 - .4 Identifying those techniques:
 - i. that appear unlikely to have the potential for climate mitigation purposes; and
 - ii. that appear to be likely to have some potential for climate mitigation purposes and that bear further detailed examination.

- 2 Providing a detailed focused review of a limited number of proposed marine geoengineering techniques that are likely to have some potential for climate mitigation purposes addressing:
- .1 The potential environmental and social/economic impacts of those marine geoengineering approaches on the marine environment and the atmosphere where appropriate.
 - .2 An outline of the issues that would need to be addressed in an assessment framework for each of those techniques, using the London Protocol Assessment Framework for Scientific Research Involving Ocean Fertilization as a template.
 - .3 Their potential scientific practicality and efficacy for climate mitigation purposes.
 - .4 An assessment of monitoring and verification issues for each of those marine geoengineering techniques.
 - .5 Identification of significant gaps in knowledge and uncertainties that would require to be addressed to fully assess implications of those techniques for the marine environment and the atmosphere where appropriate.

Product(s): Produce reports on the above work at appropriate points as reflected in the workplan. Produce final report by end January 2018 and make provisions for publication, dissemination and outreach.

WG: 42: Impacts of wastes and other matter in the marine environment from mining operations, including marine mineral mining

Lead Agency: IMO, UN Environment

Co-sponsors: tbc

Chairperson: Tracy Shimmield

Members: Bronwen Currie (Namibia), Raymond Mepstad (Norway), Cindy Van Dover (United States), James Hein (United States), Stuart Simpson (Australia), Andrew Sweetman (United Kingdom), Gi Hoon Hong (Republic of Korea)

Terms of reference for WG 42:

The working group on the impacts on tailings from mining operations on the marine environment is requested to undertake a literature review on the following aspects:

- .1 Identify and provide a better understanding of potential environmental impacts of marine disposal of tailings and associated wastes from land-based mining operations (hereinafter referred to as "mine tailings"), taking into account potential linkages between deep water ecosystems at the disposal site and other (e.g. ecological, biological) resources in the water column. The impacts could include, but are not limited to, those identified in the report of the workshop on mine tailings provided to GESAMP at its last meeting (GESAMP 42/7/1).
- .2 [Review the extent and suitability of baseline assessments (prior to any construction or discharge) conducted to date and identify the key elements for comprehensive surveys of baseline conditions from which abiotic and biotic impacts can be assessed, taking into account the latest detection technologies of marine pollution and its impact to the organisms.
- .3 Review and identify the best practices in modelling the physical and chemical behaviour of discharged mine tailings (e.g. slurries), including the shearing and upwelling of both the solids and soluble fractions, as well as the significance of tidal dispersion and potential for long-range transport of fine materials, and determine whether existing models are adequate or further development is needed.
- .4 Review and evaluate the processes of exposure and effect and the pathways for mine tailings disposal operations, including those related to the physical presence of the wastes, exposure to associated contaminants, their accumulation, and the potential effects at community level.
- .5 Implications arising from the fact that marine organisms normally used for toxicity testing are from upper layers of marine water, not the deep sea.
- .6 Review and identify physical and ecological models to estimate the recovery processes of deep sea ecosystems around the possible impacted area.
- .7 Produce a report on the above work under a time frame and any other reporting requirements to be agreed between LC/LP and the GESAMP].

Product(s): Produce a report addressing first term of reference to be presented at the next annual session. This will be followed by a review of the rest of the terms of reference in order to allow for further work on the issue.

CORRESPONDENCE GROUPS

The following activities will continue during the intersessional period:

Correspondence Group on the relevance of inputs of disinfection byproducts (DBPs) into the marine environment

Lead: Thomas Hofer (Germany)

Co-lead: Mattias Grote (Germany)

Based on the scoping paper accepted as basis for work at this session of GESAMP members will be nominated in 2017/2018 to prepare a revised scoping document in preparation for a workshop in 2018 on the subject.

Correspondence Group on the impact of residues of chronic oil spills

Lead: Felicia Chinwe Mogo (Nigeria), Ana Carolina Ruiz Fernandez (Mexico)

The Correspondence Group to develop a revised scoping paper in the intersessional period with the involvement of other GESAMP members with expertise on the issue. The paper will take into account other studies and earlier GESAMP reports on the subject.

Correspondence Group on causes and impacts of massive accumulations of the brown macro-algae Sargassum in the nearshore environment of the Caribbean and West Africa

Lead: Peter Kershaw (United Kingdom), Ahmad Abu Hilal (Jordan) Christopher Cox (UN Environment)

The Correspondence Group, together with the Sponsoring Organizations involved in the subject, will identify and define a possible role for GESAMP on how it can contribute to their efforts on the subject.

Correspondence Group on the issue of emerging pollutants in wastewater

Lead: Felicia Mogo (Nigeria) and Birguy Lamizana (UN Environment)

The Correspondence Group will revise the scoping paper in the intersessional period with a more clearly defined focus on the marine environment and possibly convene a workshop under the lead of UN Environment for consideration at the next annual session.

Correspondence Group on sand and gravel mining

Lead: Emmanuel Ajao (Nigeria) and Joana Akrofi (UN Environment)

The Correspondence Group will revise the scoping paper in the intersessional period with expanded membership for consideration at the next annual session.

Task team on updating the information on sources and levels of the main pollutants impacting the global marine environment

Lead: David Vousden (South Africa)

The task team will prepare a scoping paper in the intersessional period on possible approaches to updating the figures of "80% land based versus 20% sea-based sources of ocean pollution".

ANNEX VI - Template for new GESAMP working groups

Background and Context

The subject:

Brief description subject of the study

The nature of the issue:

Why the subject is of concern or interest to the international community from the perspective of marine environmental protection.

The justification:

Why a GESAMP study is needed (e.g. synthesis of scattered information, assessment of environmental status/impacts, development of new methodologies, establishment of standards or guidelines, identify requirements for research, monitoring, management, and/or policy development).

Terms of Reference

The Terms of Reference should:

1. Be specific, concrete, point-by-point tasks to be carried out by the WG, and/or specific information to be included in the report
2. Define the scope: what will and won't be done
3. Avoid being open-ended: focus on a specific product to be produced (usually a report)
4. Focus on the specific task being proposed
5. Identify the expertise required for the WG

Work Plan

Describe the proposed work programme and methods to carry this out, such as workshops, intersessional activities, electronic communications and online platforms.

Devise a provisional timeline, including:

1. Meeting dates
2. Milestones (drafts, reviews, revisions, etc.)
3. Deliverables and delivery date (usually publication of a report)
4. Provisions for peer review
5. Provisions for publication, dissemination and outreach (PR)

Conflicts of Interest

GESAMP depends on members of working groups acting in an independent capacity, and for the assessment and advice it provided to be reliable, authoritative and independent of any interest groups. To ensure that this process is transparent, it is necessary for each agency, in consultation with the working group Chairperson, to identify potential conflicts of interest, and devise suitable steps to address this, if required.

Administrative Arrangements

The following information should be provided:

1. Sponsor agencies
2. Additional supporting organizations
3. Proposed budget and funding sources
4. WG Chairperson(s) and members if available at time of proposal
5. Proposed Technical Secretary for the WG.

VII - GESAMP Reports and Studies publications

The following reports and studies have been published so far. They are available from the GESAMP website: <http://gesamp.org>

1. Report of the seventh session, London, 24-30 April 1975. (1975). Rep. Stud. GESAMP, (1):pag.var. Available also in French, Spanish and Russian
2. Review of harmful substances. (1976). Rep. Stud. GESAMP, (2):80 p.
3. Scientific criteria for the selection of sites for dumping of wastes into the sea. (1975). Rep. Stud. GESAMP, (3):21 p. Available also in French, Spanish and Russian
4. Report of the eighth session, Rome, 21-27 April 1976. (1976). Rep. Stud. GESAMP, (4):pag. var. Available also in French and Russian
5. Principles for developing coastal water quality criteria. (1976). Rep. Stud. GESAMP, (5):23 p.
6. Impact of oil on the marine environment. (1977). Rep. Stud. GESAMP, (6):250 p.
7. Scientific aspects of pollution arising from the exploration and exploitation of the sea-bed. (1977). Rep. Stud. GESAMP, (7):37 p.
8. Report of the ninth session, New York, 7-11 March 1977. (1977). Rep. Stud. GESAMP, (8):33 p. Available also in French and Russian
9. Report of the tenth session, Paris, 29 May - 2 June 1978. (1978). Rep. Stud. GESAMP, (9):pag.var. Available also in French, Spanish and Russian
10. Report of the eleventh session, Dubrovnik, 25-29 February 1980. (1980). Rep. Stud. GESAMP, (10):pag.var. Available also in French and Spanish
11. Marine Pollution implications of coastal area development. (1980). Rep. Stud. GESAMP, (11):114 p.
12. Monitoring biological variables related to marine pollution. (1980). Rep. Stud. GESAMP, (12):22 p. Available also in Russian
13. Interchange of pollutants between the atmosphere and the oceans. (1980). Rep. Stud. GESAMP, (13):55 p.
14. Report of the twelfth session, Geneva, 22-29 October 1981. (1981). Rep. Stud. GESAMP, (14):pag.var. Available also in French, Spanish and Russian
15. The review of the health of the oceans.(1982).Rep. Stud. GESAMP, (15):108 p.
16. Scientific criteria for the selection of waste disposal sites at sea. (1982). Rep. Stud. GESAMP, (16):60 p.
17. The evaluation of the hazards of harmful substances carried by ships. (1982). Rep. Stud. GESAMP, (17):pag.var.
18. Report of the thirteenth session, Geneva, 28 February - 4 March 1983. (1983). Rep. Stud. GESAMP, (18):50 p. Available also in French, Spanish and Russian
19. An oceanographic model for the dispersion of wastes disposed of in the deep sea. (1983). Rep. Stud. GESAMP, (19):182 p.
20. Marine pollution implications of ocean energy development. (1984). Rep. Stud. GESAMP, (20):44 p.
21. Report of the fourteenth session, Vienna, 26-30 March 1984. (1984). Rep. Stud. GESAMP, (21):42 p. Available also in French, Spanish and Russian
22. Review of potentially harmful substances. Cadmium, lead and tin. (1985). Rep. Stud. GESAMP, (22):114 p.
23. Interchange of pollutants between the atmosphere and the oceans (part II). (1985). Rep. Stud. GESAMP, (23):55 p.
24. Thermal discharges in the marine Environment. (1984). Rep. Stud. GESAMP, (24):44 p.
25. Report of the fifteenth session, New York, 25-29 March 1985. (1985). Rep. Stud. GESAMP, (25):49 p. Available also in French, Spanish and Russian
26. Atmospheric transport of contaminants into the Mediterranean region. (1985). Rep. Stud. GESAMP, (26):53 p.
27. Report of the sixteenth session, London, 17-21 March 1986. (1986). Rep. Stud. GESAMP, (27):74 p. Available also in French, Spanish and Russian
28. Review of potentially harmful substances. Arsenic, mercury and selenium. (1986). Rep. Stud. GESAMP, (28):172 p.
29. Review of potentially harmful substances. Organosilicon compounds (silanes and siloxanes). (1986). Published as UNEP Reg. Seas Rep. Stud. (78):24 p.
30. Environmental capacity. An approach to marine pollution prevention. (1986). Rep. Stud. GESAMP, (30):49 p.

31. Report of the seventeenth session, Rome, 30 March - 3 April 1987. (1987). Rep. Stud. GESAMP, (31):36 p. Available also in French, Spanish and Russian
32. Land-sea boundary flux of contaminants: contributions from rivers. (1987). Rep. Stud. GESAMP, (32):172 p.
33. Report on the eighteenth session, Paris, 11-15 April 1988. (1988). Rep. Stud. GESAMP, (33):56 p. Available also in French, Spanish and Russian
34. Review of potentially harmful substances. Nutrients. (1990). Rep. Stud. GESAMP, (34):40 p.
35. The evaluation of the hazards of harmful substances carried by ships: Revision of GESAMP Reports and Studies No. 17. (1989). Rep. Stud. GESAMP, (35):pag.var.
36. Pollutant modification of atmospheric and oceanic processes and climate: some aspects of the problem. (1989). Rep. Stud. GESAMP, (36):35 p.
37. Report of the nineteenth session, Athens, 8-12 May 1989. (1989). Rep. Stud. GESAMP, (37):47 p. Available also in French, Spanish and Russian
38. Atmospheric input of trace species to the world ocean. (1989). Rep. Stud. GESAMP, (38):111 p.
39. The state of the marine environment. (1990). Rep. Stud. GESAMP, (39):111 p. Available also in Spanish as Inf.Estud.Progr.Mar.Reg. PNUMA, (115):87 p.
40. Long-term consequences of low-level marine contamination: An analytical approach. (1989). Rep. Stud. GESAMP, (40):14 p.
41. Report of the twentieth session, Geneva, 7-11 May 1990. (1990). Rep. Stud. GESAMP, (41):32 p. Available also in French, Spanish and Russian
42. Review of potentially harmful substances. Choosing priority organochlorines for marine hazard assessment. (1990). Rep. Stud. GESAMP, (42):10 p.
43. Coastal modelling. (1991). Rep. Stud. GESAMP, (43):187 p
44. Report of the twenty-first session, London, 18-22 February 1991. (1991). Rep. Stud. GESAMP, (44):53 p. Available also in French, Spanish and Russian
45. Global strategies for marine environmental protection. (1991). Rep. Stud. GESAMP, (45):34 p.
46. Review of potentially harmful substances. Carcinogens: their significance as marine pollutants. (1991). Rep. Stud. GESAMP, (46):56 p.
47. Reducing environmental impacts of coastal aquaculture. (1991). Rep. Stud. GESAMP, (47):35 p.
48. Global changes and the air-sea exchange of chemicals. (1991). Rep. Stud. GESAMP, (48):69 p.
49. Report of the twenty-second session, Vienna, 9-13 February 1992. (1992). Rep. Stud. GESAMP, (49):56 p. Available also in French, Spanish and Russian
50. Impact of oil, individual hydrocarbons and related chemicals on the marine environment, including used lubricant oils, oil spill control agents and chemicals used offshore. (1993). Rep. Stud. GESAMP, (50):178 p.
51. Report of the twenty-third session, London, 19-23 April 1993. (1993). Rep. Stud. GESAMP, (51):41 p. Available also in French, Spanish and Russian
52. Anthropogenic influences on sediment discharge to the coastal zone and environmental consequences. (1994). Rep. Stud. GESAMP, (52):67 p.
53. Report of the twenty-fourth session, New York, 21-25 March 1994. (1994). Rep. Stud. GESAMP, (53):56 p. Available also in French, Spanish and Russian
54. Guidelines for marine environmental assessment. (1994). Rep. Stud. GESAMP, (54):28 p.
55. Biological indicators and their use in the measurement of the condition of the marine environment. (1995). Rep. Stud. GESAMP, (55):56 p. Available also in Russian
56. Report of the twenty-fifth session, Rome, 24-28 April 1995. (1995). Rep. Stud. GESAMP, (56):54 p. Available also in French, Spanish and Russian
57. Monitoring of ecological effects of coastal aquaculture wastes. (1996). Rep. Stud. GESAMP, (57):45 p.
58. The invasion of the ctenophore *Mnemiopsis leidyi* in the Black Sea. (1997). Rep. Stud. GESAMP, (58):84 p.
59. The sea-surface microlayer and its role in global change. (1995). Rep. Stud. GESAMP, (59):76 p.
60. Report of the twenty-sixth session, Paris, 25-29 March 1996. (1996). Rep. Stud. GESAMP, (60):29 p. Available also in French, Spanish and Russian
61. The contributions of science to integrated coastal management. (1996). Rep. Stud. GESAMP, (61):66 p.
62. Marine biodiversity: patterns, threats and development of a strategy for conservation. (1997). Rep. Stud. GESAMP, (62):24 p.

63. Report of the twenty-seventh session, Nairobi, 14-18 April 1997. (1997). Rep. Stud. GESAMP, (63):45 p. Available also in French, Spanish and Russian
64. The revised GESAMP hazard evaluation procedure for chemical substances carried by ships. (2002). Rep. Stud. GESAMP, (64):121 p.
65. Towards safe and effective use of chemicals in coastal aquaculture. (1997). Rep. Stud. GESAMP, (65):40 p.
66. Report of the twenty-eighth session, Geneva, 20-24 April 1998. (1998). Rep. Stud. GESAMP, (66):44 p.
67. Report of the twenty-ninth session, London, 23-26 August 1999. (1999). Rep. Stud. GESAMP, (67):44 p.
68. Planning and management for sustainable coastal aquaculture development. (2001). Rep. Stud. GESAMP, (68):90 p.
69. Report of the thirtieth session, Monaco, 22-26 May 2000. (2000). Rep. Stud. GESAMP, (69):52 p.
70. A sea of troubles. (2001). Rep. Stud. GESAMP, (70):35 p.
71. Protecting the oceans from land-based activities - Land-based sources and activities affecting the quality and uses of the marine, coastal and associated freshwater environment. (2001). Rep. Stud. GESAMP, (71):162p.
72. Report of the thirty-first session, New York, 13-17 August 2001. (2002). Rep. Stud. GESAMP, (72):41 p.
73. Report of the thirty-second session, London, 6-10 May 2002. Rep. Stud. GESAMP, (73)
74. Report of the thirty-third session, Rome, 5-9 May 2003 (2003) Rep. Stud. GESAMP, (74):36 p.
75. Estimations of oil entering the marine environment from sea-based activities (2007), Rep. Stud. GESAMP, (75):96 p.
76. Assessment and communication of risks in coastal aquaculture (2008). Rep. Stud. GESAMP, (76):198 p.
77. Report of the thirty-fourth session, Paris, 8-11 May 2007 (2008), Rep. Stud. GESAMP, (77):83 p.
78. Report of the thirty-fifth session, Accra, 13-16 May 2008 (2009), Rep. Stud. GESAMP, (78):73 p.
79. Pollution in the open oceans: a review of assessments and related studies (2009). Rep. Stud. GESAMP, (79):64 p.
80. Report of the thirty-sixth session, Geneva, 28 April - 1 May 2009 (2011), Rep. Stud. GESAMP, (80):83 p.
81. Report of the thirty-seventh session, Bangkok, 15-19 February 2010 (2010), Rep. Stud. GESAMP, (81):74 p.
82. Proceedings of the GESAMP International Workshop on Micro-plastic Particles as a Vector in Transporting Persistent, Bio-accumulating and Toxic Substances in the Oceans (2010). Rep. Stud. GESAMP, (82):36 p.
83. Establishing Equivalency in the Performance Testing and Compliance Monitoring of Emerging Alternative Ballast Water Management Systems (EABWMS). A Technical Review. Rep. Stud. GESAMP, (83):63 p, GloBallast Monographs No. 20.
84. The Atmospheric Input of Chemicals to the Ocean (2012). Rep. Stud. GESAMP, (84) GAW Report No. 203.
85. Report of the 38th Session, Monaco, 9 to 13 May 2011 (pre-publication copy), Rep. Stud. GESAMP, (85): 118 p.
86. Report of the Working Group 37: Mercury in the Marine Environment (in prep.). Rep. Stud. GESAMP, (86)
87. Report of the 39th Session, New York, 15 to 20 April 2012 (pre-publication copy), Rep. Stud. GESAMP, (87):92 p.
88. Report of the 40th Session, Vienna, 9 to 13 September 2013, Rep. Stud. GESAMP, (88):86p.
89. Report of the 41st Session, Malmö, Sweden, 1 to 4 September 2014, Rep. Stud. GESAMP, (89) :90p.
90. Report of Working Group 40: Sources, fate and effects of microplastics in the marine environment : a global assessment. Rep. Stud. GESAMP (90) :96 p.
91. Pollution in the Open Ocean 2009-2013: A Report by a GESAMP Task Team, (2015) Rep. Stud. GESAMP (91):85 p.
92. Report of the forty-second session, Paris, 31 August to 3 September 2015. Rep. Stud. GESAMP, (2015): 58 p.
93. Sources, fate and effects of microplastics in the marine environment: part two of a global assessment (2016). Rep. Stud. GESAMP, (93): 220 p.
94. Proceedings of the GESAMP international workshop on the impacts of mine tailings in the marine environment (2016). Rep. Stud. GESAMP (94): 83 p.
95. Report of the forty-third session, Nairobi, 14 to 17 November 2016. Rep. Stud. GESAMP, (2017): 72 p.

96. Report of the forty-fourth session, Geneva, 4 to 7 September 2017. (2018). Rep. Stud. GESAMP, (96), GAW Report No. 237, 66 p.



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