



**Proceedings of the 2023 Annual Meeting of the
Scientific Committee on Oceanic Research
49th SCOR Annual Meeting, Volume 59, 2023**



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Summary

This proceeding summarizes the discussions during the 49th SCOR Annual Meeting held in Guayaquil, Ecuador, 17-19 October 2023. Following the example of the 2022 annual meeting, the meeting was held in a hybrid format. Presentations were delivered either in person, remotely through Zoom, or via a submitted recording. This proceeding also provides information from and links to the background information submitted for review at the meeting, including the proposals for new working groups and the reports from current SCOR working groups, projects, capacity development activities, and affiliated and partner organizations, all of which were traditionally included in the SCOR Annual Meeting background book until 2019. All of these can also be accessed online through the SCOR website at: <https://scor-int.org/events/scor-2023-annual-meeting/>. Presentations provided as recordings from SCOR projects, working groups, and partners can be found on the SCOR YouTube channel at <https://www.youtube.com/channel/UCv-dZLizFYDOC2UTweiWj0Q/videos>. An annotated agenda was populated based on these submitted background documents and served as a starting point for the proceedings.

The SCOR 2023 Annual Meeting was attended by 88 participants from 27 countries. Of these, 26 participants from 16 countries attended on-site. The meeting was attended by 23 nominated members, as well as to representatives from projects, working groups, and partners and also interested observers. Within the framework of the SCOR 2023 Annual Meeting, a joint symposium on “Marine Sciences in Ecuador” was organized by SCOR and local host, INOCAR (Instituto Oceanográfico y Antártico de la Armada, Ecuador). The symposium covered the diversity of marine science topics of importance in Ecuador including El Niño forecasts, tsunami predictions, fisheries, and marine biodiversity of the Galapagos Islands.

The first day of the meeting consisted of reports from the SCOR president, executive director, Capacity Development Committee chair, ad hoc finance committee, and affiliated organizations (International Association for Biological Oceanography [IABO], International Association for the Physical Sciences of the Oceans [IAPSO], International Association of Meteorology and Atmospheric Sciences [IAMAS]) as well as the discussion of proposals and selection of new working groups. The second day consisted of reports from current working groups, projects, and affiliated projects. The third day consisted of reports from partner organizations. The order of the proceedings reflects the order of information in the background materials. However, the order of live presentations was scheduled based on the time zone and availability of presenters, which was not settled until closer to the meeting.

The three working group proposals approved were: (1) Coordinating the Development of Gridded Four-Dimensional Data Products from Biogeochemical-Argo Observations (4D-BGC),

(2) Global Library of Underwater Biological Sounds (GLUBS), and (3) New physiological Metrics for Oceanography from ‘Omics (NEMOO)¹.

The since the last annual meeting marked a significant return to in-person meetings. Nine working groups met in person, with at least 41 online meetings also reported. All projects were able to hold their scientific steering committee meetings since the last SCOR annual meeting. Working groups and projects reported 50 publications acknowledging SCOR, and were encouraged to ensure SCOR is acknowledged in all relevant publications.

SCOR continued to support capacity development activities. Five new SCOR Visiting Scholars were selected in 2023; additionally, six remaining Scholars selected since 2020 were able to complete their visits after delays caused by COVID-19. Seven of the “Exceptional Call” Scholars selected in 2022 completed their visits in 2023. Five POGO-SCOR Fellows were selected in 2023. Travel grants were provided to 17 meetings/trainings held in 2023, which allowed support for 57 attendees from 25 countries, for support amounting to \$87k USD.

The 2024 SCOR meeting is scheduled for 16-18 October 2024 in Qingdao, China, hosted by the China-Beijing SCOR National Committee, who will be celebrating their 40th year of activity. The 2025 SCOR annual meeting will be hosted by the Colombian SCOR National Committee in Santa Marta.

¹ As a result of review feedback, “NEMOO” was formally approved with a name change to “Physiology and Rates in Microbial Oceanography (PRIMO)”

1. Opening Topics

1.1. Welcome and Introduction to the Agenda

SCOR President Sinjae Yoo opened the meeting by welcoming participants to the second SCOR annual meeting held in hybrid mode. The agenda and written reports and presentations were available to review in advance of the meeting on the annual meeting webpage (<https://scor-int.org/events/scor-2023-annual-meeting/>). Presenters have ten minutes for their presentation and questions. In some cases, reports will be made via recording or via the SCOR Executive Committee monitor. No changes were made to the agenda.

Yoo initiated introductions of participants in the meeting room. Executive Director Emily Twigg asked that Zoom participants introduce themselves when they make a comment.

In Memoriam

Yoo led a tribute to the life and contributions of members of the oceanographic community who passed away in the last year:

Dr. Patricio Bernal (Chile) – 11 October 2022

Patricio Bernal was the science director for the CSIRO-Australia program on Coasts and Oceans, and a researcher at the Faculty of Biological Sciences of the Pontificia Universidad Católica de Chile. He was a full member of SCOR WG 73 on Ecological Theory in Relation to Biological Oceanography, and he was the executive secretary for the Intergovernmental Oceanographic Commission (IOC) UNESCO. At IOC, he pushed the development of a global tsunami warning and mitigation system and was instrumental in launching the Assessment of Assessments of the ocean, paving the way to the current series of the United Nations (UN) World Ocean Assessments.

Prof. Will de Ruijter (The Netherlands) – 12 January 2023

Dr. Will de Ruijter was a professor in physical oceanography at the Institute for Marine and Atmospheric Research (IMAU) of Utrecht University, the Netherlands. He was a full member of SCOR WG 136 on Climatic Importance of the Greater Agulhas System. His colleague Thomas Röckmann, director of IMAU (Institute for Marine and Atmospheric Research Utrecht), Department of Physics, Utrecht University, wrote, "Over his long and eminent career, Will has made landmark contributions on a broad range of topics, including the dynamics of currents and fronts in the Dutch coastal zone and, in particular, the Agulhas System off South Africa. Will leaves a large legacy in the Physical Oceanography, Coastal Oceanography and Climate research fields through his scientific papers, through his students, and through his national and

international leadership. Many were strongly influenced by his great physical intuition, broad vision, and kind personality. He will be sorely missed."

Prof. Mathieu Rouault (South Africa) – 17 January 2023

Mathieu Rouault was the director of the Nansen Tutu Center for Marine Environmental research and an associate professor in the Department of Oceanography, University of Cape Town. He was also the president of the South African Society for Atmospheric Science. In 2002, he was a POGO-SCOR Fellow joining the PIRATA (Pilot Research Moored Array in the Tropical Atlantic) FR11 cruise and receiving training in all aspects regarding deployment of the ATLAS (Autonomous Temperature Line Acquisition System) system. His research was focused on ocean atmosphere interaction from numerical modeling to experimental work at sea, from meteorology and physical oceanography to climatology and the impact of climate change and variability on marine ecosystems and water resource. His colleague Juliet Hermes wrote, "... his work on air-sea interaction over the Agulhas was seminal. The oceanographic community in South Africa are all shocked and saddened by his untimely passing."

Prof. Bjørn Sundby (Canada) – 23 January 2023

Prof. Bjørn Sundby was a retired professor from the Université du Québec à Rimouski (UQAR) and adjunct professor from McGill University in Canada. Sundby served SCOR as secretary between 1996 and 2000, as president between 2004 and 2008, and as past president between 2008 and 2012. He was a SCOR nominated member for Canada serving the Canadian SCOR Committee as secretary between 1996 and 2000 and as chair between 2003 and 2006. Sundby earned his PhD in physical organic chemistry from the University of Bergen (Norway) in 1966 and then moved to Dalhousie University in Halifax for a postdoctoral position. He was an oceanography research associate at UQAR from 1974 to 1980 and became professor of oceanography from 1980 to 1984. He was head of the Department of Chemical Oceanography and Marine Pollution at the Netherlands Institute for Sea Research from 1984 to 1987, and later the director of the Physical and Chemical Oceanography Branch at the Maurice Lamontagne Institute, Department of Fisheries and Oceans, Canada. He was professor of oceanography at the Institut des Sciences de la Mer de Rimouski (ISMER) associated to the UQAR from 1992 until his retirement in 2010, and an adjunct professor at McGill University in Montreal. His major scientific contributions are related to the importance of manganese to marine biogeochemistry, and how coastal sediments act as an important source of manganese for the deep ocean.

As pointed out by Cédric Magen, Bruno Lansard and Sean A. Crowe in their preface to Sundby's Special Issue of Aquatic Geochemistry, Sundby worked on a broad array of topics, including the marine phosphate cycle, processing of organic matter in permeable and soft sediments, transient diagenesis, the use of redox tracers as paleo indicators, micro-scale redox cycling in the rhizosphere, and the development of Au/Hg amalgam microelectrodes for measuring redox species at fine spatial scales. Through his extensive service to SCOR, Sundby contributed to shaping the focus of international oceanographic research and informing marine policy.

Prof. Miguel Dino Fortes (Philippines) – 30 April 2023

Dr. Miguel Dino Fortes was a professor at the University of the Philippines, and a full member of WG 158 Coordinated Global Research Assessment of Seagrass System (C-GRASS). Fortes was a tireless advocate for seagrasses, the people who depend on them, and for building the seagrass community of practice globally. Emmett Duffy, the co-chair of WG 158 would recall a moment during a C-GRASS meeting, with many small faces on the Zoom screen, when Miguel greeted everyone by saying “Hello, beautiful people!” To Duffy, that set the mood in an important way for the working group’s interactions and he will strive to keep his example in mind. Miguel was the author of *Seagrasses: A resource unknown in the ASEAN region*,² which was inspirational for generations to come working in seagrass beds and their relation to food security.

Prof. Vera Alexander (USA) – May 2023

Prof. Vera Alexander was a retired Professor of the University of Alaska Fairbanks. She was a member of the scientific steering committee of the Census of Marine Life project, which was affiliated to SCOR from 2000 to 2010. In 1965, Vera was the first woman to earn a PhD from the University of Alaska Fairbanks. She pursued field science, became the director of Institute of Marine Science, and was the first dean of the College of Ocean Sciences and Fisheries. Her distinguished scholarship, stewardship of marine science, and influence in marine policy have been recognized and honored nationally and internationally. Among her many achievements were 16 years of service on the Marine Mammal Commission; 12 years on the scientific steering committee of the Census of Marine Life; service as a founder, delegate, and chair of the North Pacific Marine Science Organization (PICES); and role in the development and launch of the Research Vessel Sikuliaq.

A minute of silence was observed by the meeting attendees.

1.2. Report of the SCOR President

Yoo reported on the activities of the president and Executive Committee to support and maintain various SCOR activities since the last annual meeting in Busan in 2022. Many SCOR activities have been restored to the state of pre-COVID time. Yoo attended the 32nd Session of the IOC Assembly held in June 2023 in Paris. During the meeting, progress in various activities of IOC have been reported, the UN Decade of Ocean Science for Sustainable Development (hereafter “UN Ocean Decade”) in particular. The UN Ocean Decade has established many Decade Actions addressing the UN Ocean Decade Challenges. At the IOC Assembly, SCOR made a statement that it will keep supporting the UN Ocean Decade. Yoo reminded participants that SCOR participates in the proclamation of an International Year of Basic Sciences for Sustainable Development (IYBSSD) as a member of its scientific steering committee (SSC). The IYBSSD has completed one full year of planned activity. Yoo noted that participants could ask Marie-

² Fortes, M. D. 1989. *Seagrasses: a resource unknown in the ASEAN region*. ICLARM Education Series 5, 46 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Alexandrine Sicre for more information about the IYBSSD. In July, Yoo appeared in a talk show on KBS, a national TV network in Korea to talk about climate change and marine ecosystems in this science communication program. In September, he gave a keynote speech on SCOR's activities at a conference commemorating the 50th anniversary of KIOST. He is also participating in the panel of External Review of PICES, a SCOR partner. This panel will assess PICES' achievements and make recommendations for the future directions of the ocean science organization.

1.3. Report of SCOR Executive Director

Twigg, executive director of SCOR, provided an overview of the activities conducted under SCOR based on the reports received in advance of the annual meeting, as well as the activities of the Secretariat. Twigg started service as Executive Director in June 2023 and has since participated in virtual meetings of SSCs, provided recorded opening remarks for the Southern Ocean Observing System (SOOS) inaugural symposium, and attended the GEOTRACES SSC meeting in person.

Twigg reviewed the current activities of SCOR. At the time of the annual meeting, SCOR maintains 18 working groups, five large-scale research projects, five infrastructure projects, several capacity development programs, and has three affiliated projects. Twigg informed the participants that the process for project affiliation to SCOR was revised in May 2023 and affiliated projects will be reviewed annually by the SCOR Executive Committee for continuation of their affiliation. Six hundred sixty-eight people from 61 countries were involved with SCOR at some point in 2023. Of these, 380 were male and 288 were female. Looking at the leadership (chairs, co-chairs, vice-chairs) of SCOR's activities, gender is more evenly split with 38 males and 40 females in these positions. Twigg reviewed membership on the Executive Committee and changes to the nominated membership from the 32 national committees.

In 2023, several members of the SCOR community were recognized for their achievements: Trevor McDougall (Australia) received the Australian Prime Minister's Prize for Science. Marie-Alexandrine Sicre (France) was appointed 2022 Fellow of the International Science Council (ISC), and Shubha Sathyendranath (UK) was appointed Member of the Order of the British Empire.

Twigg reviewed the meeting activity of working groups and projects. Nine working groups met in person, with at least 41 online meetings also reported. All projects were able to hold their SSC meetings since the last SCOR annual meeting. Twigg noted that meeting planning guidance available on the SCOR website had been revised to clarify budgeting procedures and identify the specific meeting documentation requested by SCOR from organizers. She also informed the participants that SCOR would continue the policy to allow travel support for associate members of working groups.

Twigg noted the number of publications from working groups (18) and projects (32) that include acknowledgment of SCOR, reminding everyone to acknowledge support from SCOR so their publications could be considered as metrics. Several working groups and projects are associated with the UN Ocean Decade and Twigg requested that chairs ensure SCOR is informed as endorsements by the UN Ocean Decade are received.

Twigg provided a brief overview of SCOR's finances, which would be covered in more detail by the ad hoc Finance Committee. Dues income surpassed estimates due to the payment of dues in arrears. SCOR currently maintains two grants from the National Science Foundation (NSF) to support some projects and working groups. One is in a no-cost extension to spend unspent travel funds from COVID-19 and the other is in its third year. SCOR is also in a no-cost extension year for an NSF grant to support SCOR's capacity development programs and has submitted a proposal for the next grant to begin on 1 January 2024.

Regarding outreach resources, SCOR has a video, flyer, and photo gallery from 2022 for use, which will require updating soon. SCOR has a social media presence on X (Twitter), the website, and through the email list. SCOR has paused activity on Facebook. SCOR has a new community in Zenodo (<https://zenodo.org/>) where SCOR activities can link their products. SCOR also has communities in the Ocean Best Practices portal and AquaDocs. SCOR will have a booth at the Ocean Sciences Meeting in 2024, which working groups and projects can use for outreach.

1.4. SCOR Compiled Capacity Development Activities

Rebecca Zitoun, chair of the SCOR Capacity Development Committee, provided an overview of SCOR's capacity development activities in 2023. These activities include the SCOR Visiting Scholars, the POGO-SCOR Fellowship Programme, travel support to scientists from developing countries to attend meetings and conferences, and the African Regional Graduate Networks in Oceanography (A-RGNO). Additional capacity development activities are carried out by the SCOR projects through summer schools. SCOR also builds capacity through the encouragement of early-career and developing-country scientists in SCOR working groups and projects.

This year, five SCOR Visiting Scholars were selected out of nine applications. Scholars were hosted in Seychelles and Cameroon for the first time in 2023. Since inception of the program, there have been 55 Scholars from 24 home countries visiting 25 host countries. Five POGO-SCOR Fellows were selected out of 46 applications. Travel grants were provided to 17 meetings/trainings held in 2023, which allowed support for 57 attendees from 25 countries, for support amounting to \$87k USD. Zitoun showed a map of the home countries of travel grant recipients since data collection began in 1999. Recipients are selected by the meeting organizers and approved by SCOR. Most recipients come from Asia or South America, whereas fewer recipients come from Africa. Zitoun described updates made to the travel grant application

procedures and website. Notably, “early career” has been redefined to mean students or graduates 10 years or less post-degree. Additionally, the Capacity Development Committee is also implementing quarterly deadlines for travel grant applications.

The A-RGNO was unable to run a course in 2023 due to the R/V *Welwitschia Mirabilis* being out of service. A renewal of the Memorandum of Understanding between SCOR and the University of Namibia is pending plans for a new course and a response to SCOR’s 2022 review of the program.

During the discussion, SCOR Executive Committee member and president of IABO, Judith Gobin, expressed interest in increasing involvement of Small Island Developing States in SCOR’s Capacity Development activities. It was discussed that nominated members could help to advertise and communicate information on capacity development in their countries.

1.5. Report of the 2023 ad hoc Finance Committee

The ad hoc Finance Committee is constituted annually and is composed of nominated members who do not serve on the Executive Committee. Núria Casacuberta Arola (Switzerland), Marcela Cornejo D’Ottone (Chile), Dan Costa (USA), Brett Molony (Australia), and Paul Myers (Canada) compose the 2023 committee. Their task was to (1) review the 2022 auditor’s report of SCOR’s finances, (2) review the final 2022 budget, (3) consider approval of the 2023 revised budget, (4) consider approval of the 2024 draft budget (including recommending how many working groups can be selected in 2023), and (5) determine dues increases for 2025. The committee met over three virtual meetings with Twigg and SCOR Financial Consultant Ed Urban. Myers presented the outcome of their remote meetings and deliberations in a remote presentation at the annual meeting.

The cash balance of SCOR’s finances (discretionary and nondiscretionary combined) increased from \$423k at the end of 2021 to \$474k at the end of 2022. The auditor’s report had no special remarks to consider. The committee recommended acceptance of the 2022 financial statements.

Myers described the revised 2023 budget, originally approved in 2022. Income was higher than estimated as a result of payments of dues in arrears from Russia and additional funds remaining in NSF grants. Regarding spending, WGs spent about 30% of what was budgeted for 2023 because not all working groups held meetings and the meetings that were held were under budget. The end-of-year unrestricted net assets are currently estimated to be around \$600k.

The forecast for 2024 income included a recommended 3% increase in dues and a recommendation for up to three new working groups selected in 2023. The expected unrestricted net assets at the end of 2024 based on the budget is \$460k. The committee also recommended continuing to meet virtually in advance of the annual meeting.

Twigg clarified in response to a question that a new grant for projects and working groups are obtained every three years from NSF even in the case of underspending on travel because a new grant is needed to fund the subawards to the International Project Offices (IPOs) that receive SCOR's NSF funding. Most remaining travel funds are expected to be expended soon and any additional remaining funds would be accounted for in the next proposal.

2. Working Groups

2.1 New Working Group Proposals

Yoo outlined the importance of the working group proposal reviews and discussion at the annual meeting with the national committees. SCOR Executive Committee reporters provided a 10-minute presentation about each proposal with additional time for clarifying questions after each presentation. After the presentations, the scores would be presented for comparison to identify a clear separation of scores.

2.1.1. 4D-BGC: Coordinating the Development of Gridded Four-Dimensional Data Products from Biogeochemical-Argo Observations

Abstract: Substantial advances in oceanographic observation have been made in recent decades, allowing scientists to address questions relating to ocean physics and biogeochemistry on previously unattainable spatial and temporal scales. Remote sensing technology (1970s-pres.) has enabled highly resolved views of surface ocean properties and the Argo array (2000s-pres.) has generated unprecedented ocean interior temperature and salinity observations. The Biogeochemical (BGC) Argo array has grown over the early 21st century, and its planned expansion will soon generate ocean interior carbon, oxygen, nutrient, and optical data with near-global coverage. Four-dimensional (4D; latitude \times longitude \times depth \times time), gridded, and gap-filled data products of these ocean interior properties are being developed. These products will enhance data accessibility and ease data interpretation, transforming our understanding of ocean biogeochemical processes such as carbon fixation, export and remineralization, ocean acidification, deoxygenation, and nutrient cycling. Regular updates to these 4D-BGC products will allow scientists and decisionmakers to monitor changes to important biogeochemical processes in near-real-time. We propose a SCOR working group to facilitate discussion and coordination among different scientific communities around developing, validating, and distributing 4D-BGC products from observational datasets, with a focus on the BGC-Argo array. The emphasis on international and cross-disciplinary collaboration, aimed at addressing global

oceanographic challenges, makes this topic highly suitable for a SCOR working group. The ultimate goal of this initiative is to significantly enhance access and utility of BGC observations through 4D-BGC products, and thus refine our understanding of ocean biogeochemistry, improve models and reanalysis products, and inform policy decisions.

Wee Cheah summarized the proposal and the review comments for the meeting attendees. Overall, the reviews identified the working group as timely, a priority topic for ocean science, and appropriate for SCOR. Many also observed that the Terms of Reference (ToRs) are ambitious for the time allotted for a SCOR working group, but potentially achievable because of the expertise and connections represented in the group membership. Most reviewers considered the ToRs to be appropriate. However, the order of some ToRs needed to be rearranged because some of the later ToRs must be achieved before the earlier ones. Additionally, some reviews found the capacity development component to be superficial and the proposal could include more training for inexperienced scientists. Regarding the membership, most reviewers found the membership to be appropriate, but it was suggested that more developing country scientists could be included. Specifically noted were insufficient representation of members from India, Asia, and the Global South.

The reviews received in advance of the meeting resulted in 13 Must Fund, 6 May Fund, and 1 Do Not Fund ratings. The proposal was ultimately selected for funding.

2.1.2. Assessing Microplastic Impacts & Transport in Upwelling Systems (AMITUS)

Abstract: Upwelling Systems (UpS) are a key bridge between land, the open ocean, and the troposphere, with transport potential for microplastics. Here we focus on major UpS with significant exposure to plastics pollution; the eastern boundary UpS of the California, Humboldt, Canary, and Benguela Currents, and the seasonal upwelling system in the Gulf of Guinea (Fig. 1). Rivers and coastlines in UpS-bordering countries contribute tens of thousands of metric tons of plastic pollution per country each year to the ocean, but how much of this plastic arrives in the open ocean, in what form and by what pathways, remain open questions. In addition, because of their high biological productivity, which attracts commercial fishing activity, oceanic sources of plastic pollution in UpS could be significant. Satellite data indicate the UpS are hotspots of microplastics contamination. But baseline measurements of microplastics contamination of the water column are lacking in all UpS. Preliminary observational work suggests that high biological activity in the UpS could exacerbate and amplify microplastic biogeochemical impacts in these regions of commercial importance. Global ocean modeling tentatively confirms this, with global biogeochemical consequences that might rival the impacts of climate change. Given their potentially large role as a microplastic source to the Earth system, their vulnerability and economic importance, from a global perspective, it is important to understand how plastic pollution is impacting these systems and what mechanisms control its flow through them. This is the aim of AMITUS, which will bring together experts for a global synthesis.

Ilka Peeken summarized the proposal and the reviews. Reviewers agreed that microplastics are a critical issue for a working group to address. However, reviews were split on whether there is enough evidence to suggest that upwelling systems (UpS) are a priority focus. In that respect, some reviews stated that it is not clear what the evidence base is that the working group would build their synthesis, conceptual model, and policy recommendations from. Some reviews indicated the justification for the focus on UpS could be strengthened. The rationale section of the proposal points to the complexity of microplastic distribution in the ocean but reviewers did not agree the evidence clearly indicates UpS are a priority. Reviewers were also concerned that the ability to accomplish much of the capacity development is uncertain because it relies on obtaining funding for a summer school.

Reviewers questioned if existing working groups or other efforts from the Scientific Committee on Antarctic Research (SCAR) and GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) were better suited to tackle the issue. Additionally, the proposal identified relevance to SCOR WGs 153 and 155, but members of these working groups should already be engaged in the proposed plan. Reviewers noted that marine plastics is a very active area, and the proposal could better justify the linkages to these programs and the value added by this working group to other efforts, both those named in the proposal and others (ICES [International Council for the Exploration of the Sea], OSPAR, or HELCOM [Baltic Marine Environment Protection Commission]).

Reviewers stated that understanding the behavior of microplastics in UpS would be critical to understanding their impacts. However, this is not clearly included in the proposed activities and key areas of expertise are missing from the membership including expertise in terrestrial inputs, physical oceanography, and modeling. The inclusion of developing country scientists in the membership was noted as a benefit. However, it was seen as a missed opportunity to not include representatives from regions of other UpS including Southeast Asia, India, Ecuador, and California (USA, which is one of the UpS of focus in the proposed working group). Inclusion of social scientists and policymakers early in the working group activities are necessary in order to produce policy and program recommendations. Reviews said it was not clear to reviewers how ToR 2 will be translated into policy recommendations for ToR 3 and 4.

The reviews received in advance of the meeting resulted in 4 Must Fund, 11 May Fund, and 5 Do Not Fund ratings. The proposal was not selected for funding.

2.1.3. Data Insight through the Value of Eco-marine-robotics (DIVE)

Abstract: New observational robotic platforms significantly enhance ocean observations and have the potential to fill the crucial data gaps near shore, off-shore and in the deep sea, as they are capable of reaching some of the most remote areas of the planet. However, these platforms are missing fundamental elements that are limiting their wide-spread adoption by marine

scientists: cost, ease of operation, data validation, overall standardisation and interoperability. The primary outcome of an observational oceanographic mission are data and physical samples, but data policies applied in ocean sciences are not fully adopted in marine robotics, possibly compromising the quality of the data and limiting its broad use. This is because of the lack of data standards in marine robotics research. DIVE aims at advancing best practices used in the marine sciences data management and at ensuring their implementation by the marine robotics community. These practices will include categories such as mission planning strategies, operational procedures, sensor configurations, data formats and post processing standards. Within these categories, there will be instances of calibration and logging requirements, as well as data treatment and processing protocols, and finally dataset publication guidelines. Marine robot capabilities and the needs of oceanographic observations are continuously evolving; this co-evolution poses a considerable challenge when establishing comprehensive data and observational standards. Ultimately, inspired by successful programmes such as Argo, DIVE will explore existing standards that can be harmonised and established within internationally recognised bodies such as ISO (International Organization for Standardization) or IEEE (Institute of Electrical and Electronics Engineers).

Bradley Moran summarized the proposal and the review comments. Many reviews found the proposed working group to be timely given the proliferation of marine robotic systems, which can expand the resolution of ocean observing capabilities, especially in complex environments. A standardized approach for mission planning, sensor calibration and data dissemination lags robotics increasing use, potentially limiting some of the applicability of these datasets in ocean ecology and climate monitoring. Detracting from the purported timeliness are the insufficient data sets and data standards, as identified in the proposal. The working group aims to harmonize data protocols and enable better data integration and synthesis, helping to ensure that continued technology development will meet data collection needs to advance understanding of the ocean. In this regard, the project is a priority for ocean science and SCOR. However, detractors note experimental robotics have yet to achieve broadly adopted operational status, and that this working group presents more of a best practice for robotic deployments than on data collection itself.

Review comments about the ToRs were mixed for the work as proposed, but generally leaning towards not appropriate, not well described, lacking specificity, and insufficient in detail for realistic deliverables. Several reviewers noted areas for improvement include bolstering technical expertise, communication capabilities, and better alignment with available resources, data quality, and clarity of expected outcomes. Reviews found there to be generally good expertise, gender, and geographic balance with 17 countries represented, though no members from China or Japan, a lack of industry involvement, as well as a lack of early-career scientists.

The reviews received in advance of the meeting resulted in 10 May Fund and 10 Do Not Fund ratings. The proposal was not selected for funding.

2.1.4. Foraminifera in Extreme and Rapidly Changing Environments (FIERCE)

Abstract: Information contained in foraminifera shells is essential for understanding Earth's past climate system. Most foraminiferal proxies (indicators of, for example, temperature, productivity, or seawater chemistry) and calibration efforts have focused on tropical-subtropical planktic species that live primarily in the sunlit ocean. There are limited foraminiferal proxies from species that occupy deeper habitats (below the sunlit mixed layer to ~1000m) and more 'extreme' environments currently experiencing rapid climate change (i.e., oxygen minimum zones, the ice-ocean interface, high-latitudes). The lack of proxies in deeper and extreme environments limits our ability to reconstruct past conditions and hampers future climate change prediction efforts in these regions. The multi-disciplinary FIERCE WG will test and fine-tune state-of-the-art research methods for studying FIERCE species at a workshop in Peru and with WG members in the Norwegian Arctic. A robust synthesis of research methods will be developed into best practice 'standard operating procedures' (SOPs) for studying FIERCE species, to be published in an open-access, online platform. The SOPs will be broadly applicable to all planktic species and many benthic foraminifera, which expands the outcomes of this project beyond FIERCE species. Our focus on foraminifera from understudied habitats will improve our understanding of the biology and ecology of planktic foraminifera living in these environments, closing a critical research gap, and vastly expanding the utility of fossil foraminifera beyond the ocean's sunlit mixed layer. Given the interdisciplinary and international nature of our vision, a SCOR working group is the best and most practical choice to achieve the proposed goals.

Sicre summarized the proposal and the reviews. Reviewers generally felt that the proposal was timely and important. They recognized that foraminifera are understudied outside of shallow-water environments. By developing standard operating procedures, the working group contributes to filling a gap in understanding the current and past climate, although the detection of "extremes" could be challenging. Though there is limited data, it should be sufficient for a best practices guide. However, not all reviewers found the topic to be a priority at this time. Some reviews expressed concern about whether there were enough existing studies to reach the goals. One particular concern from the U.S. national committee was that it wasn't clear from the proposal that the distribution of specific foraminiferal species could be easily distinguished and therefore may not be informative for identifying oxygen minimum zones or high-latitude conditions. Some national committees found that FIERCE does not represent novel science and does not tackle important conceptual issues blocking advancements.

In general, national committees found the ToRs clear. However, some were concerned that the workshop in Peru is overambitious, with many goals related to ToR 2 and ToR 3 meant to be accomplished at this event in the working group's third year. Additionally, the full execution of the workshop relies on additional funding—including for important early-career scientist participation, with no backup plan if funding is not obtained.

A number of national committees commented that there was not enough global diversity and stated that members from other developing regions (Africa, Indian Ocean region, South Asia, and/or the Middle East) should be included. The group would benefit from more modelers and data scientists and one review considered the lack of a specific ‘omic’ component to the proposal to be a major omission. A review noted the project would benefit from a solid data compilation, harmonization, and management plan.

The reviews received in advance of the meeting resulted in 4 Must Fund, 13 May Fund, and 3 Do Not Fund ratings. The proposal was not selected for funding.

2.1.5. Fine-scale near-surface stratification in the Polar Oceans (FINESS)

Abstract: Summer sea-ice and snow melt in the Arctic can result in persistent, thin (< 1 m) meltwater layers under and around ice floes, with observations, albeit limited, going back to Nansen’s Fram expedition in 1893. Similar layers have also been observed in the Antarctic sea-ice zone, but they show much greater variability in duration and extent. In addition, increased freshwater release into the polar regions from glacial melt and riverine input can impact the coastal environments of Greenland, the Siberian Arctic, and Antarctica. The importance of such layers for many aspects of the Arctic system have recently been highlighted with interdisciplinary observations in pack- and landfast sea-ice. Yet historically, such observations are poorly described in the literature and measurements are challenging without disturbing the stratification. In particular, the current lack of representation of such thin meltwater layers in global and regional models is a significant limitation in understanding the climate system. This working group will synthesize the most important impacts of fine-scale salinity stratification in polar regions, and how they influence globally-relevant processes associated with exchange of gases, aerosols and energy across the water-ice-air interface. We will use existing observations to evaluate our current knowledge on physical, biological and chemical processes and facilitate recommendations on future observations, sampling and parameterizations in global climate models. We will build and strengthen existing cross-cutting relationships in this field through regular online meetings, and a series of workshops discussing new observations and relationships with existing datasets.

Stefano Aliani summarized the proposal and its reviews. Generally, reviewers found this to be a timely topic. The Japanese national committee noted that rapid ice melting in polar oceans underscores the working group’s timeliness, considering its significant recent occurrence. However, several reviews (Canada, China) commented that data appears too limited, especially for the Southern Ocean, and focus on observations would be better (Korea). This makes it difficult to evaluate the importance of parameterizing surface meltwater layers in global climate models. This lack of data also limits the feasibility of the proposed work. As presented, several reviews (Russia, IAPSO) thought the needs related to freshwater surface layers appear more appropriate for a research proposal rather than a SCOR working group.

Many national committees found the ToRs clear. However, it was not clear to reviewers how field campaigns in the next few years could be informed by the working group (Objective 3), especially given that cruises already have set objectives. Reviewers also wanted to better understand the dependence on accessing unpublished datasets in addition to the publicly available data. It wasn't clear how important the inclusion of unpublished data will be for the synthesis and subsequent application in parameterizations for climate models.

Regarding the membership, reviewers found a diversity of expertise and origin—including from the Global South—but other national committees found there to be too many members from the same institution or same country represented. The inclusion of early-career researchers is a strength of the proposal; however, reviewers thought that mentorship/support from more senior scientists should be better included in the work plan. One review suggested referring to the IASC Action Group on Indigenous Involvement (2017-2020) to involve Indigenous peoples and incorporate Indigenous/traditional knowledge.

The proposal reviews resulted in 7 Must Fund, 8 May Fund, and 6 Do Not Fund ratings. The proposal was not selected for funding.

2.1.6. Global Library of Underwater Biological Sounds (GLUBS)

Abstract: Aquatic environments encompass the world's most extensive habitats, rich with sounds produced by a diversity of animals. Passive acoustic monitoring is an increasingly accessible remote sensing technology that represents an unprecedented, non-invasive method to monitor these environments. Detection of sound-producing species assists in mapping their spatiotemporal distribution and biologically important areas. With worldwide biodiversity in significant decline and underwater soundscapes being altered as a result of anthropogenic activities, there is a need to document, quantify, and understand biotic sound sources—potentially before they disappear. A vital step towards these goals is the development of an accessible platform that: 1) integrates and expands existing repositories to provide a global reference library of known and unknown biological sound sources; 2) houses a data repository portal for annotated and unannotated audio recordings; 3) develops artificial intelligence tools to extract and characterize sounds; 4) includes benchmark training datasets for signal detection and classification; and 5) promotes public awareness of aquatic sound. Although individually, these resources are often met on regional and taxa-specific scales, many are not sustained, and collectively, an enduring global database on an integrated platform has not been realized. A Global Library of Underwater Biological Sounds will address this by developing applications to complete items 1 to 4 and, in doing so, engage the general public through associated reference material. To complete this, our working group, currently placed under SCOR's working group 'International Quiet Ocean Experiment', includes expertise of bioacousticians, bioinformaticians, propagation experts, web engineers, and signal processing specialists (e.g., artificial intelligence).

Moran summarized the proposal and its reviews. National committees found this to be a well-constructed proposed working group that would advance underwater acoustics, physics, and marine biology. It is recognized that this field is rapidly developing, and the compilation of large amounts of data would improve the general understanding and interpretation of ocean sounds. Several reviews noted the ongoing SCOR-sponsored International Quiet Ocean Experiment (IQOE), which some thought may diminish the priority of this working group until the results of IQOE are fully realized. Several reviewers noted that there are perhaps too many ToRs and noted that a few were unrealistic in the proposed timeframe. There were also some concerns raised about the proposed use of artificial intelligence (AI) models and related technical/computation expertise. The proposed membership generally reveals good international representation from 14 countries and a good gender mix. Additional questions were raised about the maintenance and updating of the proposed new database at the conclusion of this working group.

The reviews resulted in 6 Must Fund, 8 May Fund, and 5 Do Not Fund ratings. The proposal was ultimately selected for funding.

2.1.7. Towards best practices for Measuring and Archiving Stable Isotopes in Seawater (MASIS)

Abstract: The stable isotopic composition of seawater and the carbon isotopic composition of dissolved inorganic carbon are essential ocean tracers that have been widely measured since the 1960s. They are particularly important to measure well in times of wide-spread changes in the hydrological cycle, the bio-geochemical cycles, as well as the anthropogenic carbon penetration and induced acidification of the oceans, because they serve as a fingerprint of these ongoing changes. However, substantial issues of data collection, quality control, and compilation exist: common reference materials in seawater are not widely available, analysis methods have strongly diversified, regular intercomparison exercises are lacking, and as a result, large differences exist between different data sets. These differences currently prohibit the community from making full use of the potential of stable isotopes to identify climatic changes. This working group is dedicated to remedying the current issues of data collection, quality control, and compilation of stable isotopes in seawater. First, we will assess the validation stage of the available stable isotopic datasets, as well as corresponding metadata. This effort will lead to a report of best practices from sample collection to measurement and quality control. Second, we will review current methods of bias adjustment in archives and make recommendations for the future to standardize these bias adjustments. Third, we will work towards complementing existing databases, with particular effort on surface ocean sampling data. In parallel with the aforementioned efforts, the working group will promote intercomparison exercises, and will actively carry out capacity-building.

Peter Croot summarized the proposal and its reviews. Many reviews found the proposed working group to be addressing an important topic. Isotopic measurements in water are a useful tool to determine seawater sources and the physical and chemical processes involved in its distribution.

The different sampling and analysis techniques, in addition to the lack of reference material and intercalibrations, mean this working group could help reduce knowledge gaps and establish sampling, analysis, and interpretation criteria. In principle, these are appropriate activities of SCOR working groups. However, not all reviewers found the working group to be filling an urgent or novel need requiring a SCOR working group. Some reviewers suggested the need may be to better develop national capabilities in order to ensure quality isotope measurements.

A review commented that the work plan seems to be missing a team to determine how best to prepare and maintain seawater reference material for each of the isotope tracers of interest. Reviewers commented that the evaluation of the accuracy of data should be done before undertaking an intercalibration exercise. A review suggested inclusion of additional approaches for measuring C and O isotopes such as Membrane Inlet Mass Spectrometry (MIMS). Additionally, issues with long-term storage of samples also need to be considered, particularly with regard to filtration or the use of preservatives (e.g., alternatives to HgCl₂). Finally, it was noted that there are a large number of laboratories where these measurements are carried out and it is not clear how this group would reach out to this diverse community. One option offered was an interactive website or discussion forum to facilitate ongoing communication and knowledge sharing.

The proposal received 4 Must Fund, 10 May Fund, and 5 Do Not Fund ratings. It was not selected for funding.

2.1.8. Monitoring Ocean Health: Assessing the global state and trend in phytoplankton biomass and biodiversity (MOHealth 2024)

Abstract: During the Anthropocene our biosphere has been increasingly impacted by humans including significant impacts on ocean ecology (Bindoff et al., 2019). The cumulative impacts of these changes are not well predicted by even our most sophisticated models. There is a fundamental need for a monitoring program that allows these impacts to be observed. We require the data and tools to assess the impacts of these changes and guide responses including efforts to ameliorate, mitigate and manage. Wide consultation within the oceanic community has developed the essential ocean variables (EOVs) needed to underpin global oceanic monitoring (Miloslavich et al., 2018) including some for phytoplankton (Muller-Karger and Kudela 2016). The current monitoring methods need a systematic review to ensure they are fit for purpose. This proposal is for a SCOR WG to review, further develop, test, and refine a set of plankton measurements that are a robust, reliable, and quantitative description of the state and trends in the ecological health of our oceans.

Judith Gobin summarized the proposal and its reviews. Reviews agreed that understanding variability of phytoplankton biomass and abundance across different spatial and temporal scales is important as an indicator of ocean health and requires standardization of methods. However, even though the topic is very important, some reviewers stated that it is too general and/or

ambitious for a working group, given a vast variety of methods and approaches to be addressed. Reviewers thought the ToRs were too wide ranging and not well integrated with each other. Additionally, some can be addressed with a more conventional research approach (ToRs 4, 5, and 7), and some are so complex that they may not be able to achieve within 3-4 years (e.g., ToR 7). Focusing on making contributions in a particular area, such as limiting the task to satellite measurements or genomics, was suggested as more achievable for a working group.

Additionally, many reviewers also noted that this area of work, including from a past SCOR working group (WG 154 Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs), is widely developed; it wasn't clear from the proposal how the working group would build on existing efforts to provide a unique contribution. Reviewers thought the deliverables could also be better defined, noting that despite the number of ToRs, the working group might produce as few as 2-3 publications. It is not clear if or what new ocean monitoring capacities may be improved as an outcome. The reviewers also did not find the audience for the working group's products other than the Global Ocean Observing System (GOOS) to be well described. Improvements to the membership suggested by reviewers include inclusion of expertise in phytoplankton/lower trophic level ecosystem modeling, and Arctic or Subarctic experts.

The proposal received 2 Must Fund, 9 May Fund, and 9 Do Not Fund ratings. It was not selected for funding.

2.1.9. New physiological Metrics for Oceanography from 'Omics (NEMOO)³

Abstract: The need to understand how ocean global change affects marine life has exposed gaps in our knowledge of fundamental principles. Although molecular biological techniques, particularly 'omics (genomics to proteomics), now dominate research in biological oceanography, physiological research has stagnated, leading to the assumption that physiology is outmoded. However, biological rates and biogeochemical fluxes remain the main currencies in biogeochemistry (BGC) models in which microbes play a central role. The question we aim to address – with a focus on marine microbes – is how to translate 'omics-based information on physiological potential into quantifiable physiological rates, and ultimately into BGC processes that can be represented in Earth system models. While 'omics has revealed patterns in marine microbial diversity and metabolic pathways, it largely provides only static snapshots of physiological potential. Studies that weave 'omics and physiological rates together provide greater insights and improved mechanistic understanding. But despite these advances, there is widespread frustration about the paucity of physiological metrics, as most of these metrics were devised before the molecular biology revolution. To improve our understanding of the roles of marine microbes in biogeochemical cycles, we need better tools to quantify physiological

³ As a result of review feedback, "NEMOO" was formally approved with a name change to "Physiology and Rates in Microbial Oceanography (PRIMO)"

activity. Physiological rates quantify the integrated activity of proteins that drive marine BGC cycles and can bridge the gap between 'omics and biogeochemistry. We propose the development of a community and framework for co-designing physiological metrics as currency converters to link 'omics datasets and BGC models, a central aim of the international BioGeoSCAPES program.

Yoo summarized the proposal and its reviews. Overall, the reviews identified the working group as timely, a priority topic for ocean science, and appropriate for SCOR. The ability to translate 'omics' data as it becomes increasingly available to physiological rates is challenging but poised to be a highly rewarding effort. Several national committees noted particularly the absence of scientists from South America and Latin America in the working group's activities and expressed a desire for inclusion of more early-career researchers. It was suggested that the working group should propose a new acronym; "NEMOO" was identified as being too similar yet unrelated to "NEMO," the Nucleus for European Modelling of the Ocean.

The proposal received 8 Must Fund, 9 May Fund, and 2 Do Not Fund ratings. The proposal was selected for funding.

2.1.10. Oceanic Salt Intrusion into Tidal Freshwater Rivers (SALTWATER)

Abstract: About two-thirds of global freshwater supplies come from surface waters such as the tidal fresh region of estuaries. Although much is understood of the salt transport by residual circulation and shear dispersion in the mesohaline region of estuaries, little is understood of the salt transport in the oligohaline and tidal fresh regions of estuaries where tidal dispersion and river flows are expected to be more important. This gap in scientific understanding has recently been exposed in a number of headline news reports on the salt contamination of drinking water supplies in tidal rivers. Three outstanding issues have been identified. First, there is a paucity of observational data to document the salt intrusion into tidal rivers. Second, the riverine/seawater mixture includes dissolved salts produced during runoffs from the land surface and has a relative salt composition different from that of seawater. Third, hydrodynamic models used to study the saltwater intrusion employ a number of numerical schemes, varying grid resolutions, and different parameterization schemes for unresolved subgrid processes. Given the general lack of observational data for the model validation, it is unclear how well these models capture the salt intrusion. This SCOR Working Group will bring together an international team of experts to discuss recent research on the saltwater intrusion into tidal rivers around the world. Our goal is to develop a global synthesis of this emerging topic, discern the roles of climate change and local anthropogenic processes, and develop tools for observing, modeling and analyzing salt intrusion into tidal rivers.

Hans van Haren summarized the proposal and its reviews. Reviewers found the proposal to present a compelling case to better understand and predict changing salt transport dynamics of tidal rivers due to climate change and local anthropogenic forcing. The timeliness is underscored

by the impact of such changing estuarine conditions on regional freshwater supplies in many locations around the world. Generally, most reviewers found the proposal to be well written, with clear and achievable ToRs and work plan. However, a number of reviews did not consider it a priority for SCOR due to its estuarine rather than ocean focus. It was noted during the discussion, however, that the working group would make contributions toward TEOS-10 (Thermodynamic Equation of SeaWater 2010) and thus have relevance to ocean science. Some reviews found the proposal to read more like a research proposal. Given the proposal's reference to a number of studies underway in different locations, it was suggested that special sessions at large conferences might be a more effective way to bring researchers together who work on this problem. Reviewers did not find there to be sufficient detail regarding how the open-access data repository would be established and maintained, and submissions from the community solicited.

The proposal received 4 Must Fund, 11 May Fund, and 5 Do Not Fund ratings. It was not selected for funding.

2.1.11. Studying Worldwide Impacts of Calcification Trends on CHanging Climate (SWITCH)

Abstract: Ongoing fossil fuel burning affects the flow of carbon between the air, ocean, soils and biosphere and results in global warming, rising sea levels and acidifying and deoxygenating oceans. Climate models predict the consequences of rising greenhouse gas concentrations and guide measures to keep global warming under control¹. The uncertainties associated with those models' outcomes are largely resulting from an incomplete understanding of the (biological) feedbacks within and between the various carbon sinks and sources^{2,3}. Among such feedbacks, those in the ocean may have a particularly large effect on carbon cycling due to the size of marine carbon reservoir. In particular: *An integrated understanding of marine calcification is of crucial importance to understand the future of the marine carbon cycle and ocean-based solutions. This proposal aims at this by integrating across the regions, disciplines, combining observations, modelling and experimental approaches. This can only be achieved by an interdisciplinary and international collaboration, ideally as a SCOR working group.*

Field studies and laboratory experiments have indicated different and even opposing trends in the response of marine calcifiers under multiple stressors^{4,5}. This may well reflect the multiple, independent evolutionary developments of marine calcification⁶. This in turn, may mean that the mechanisms by which organisms form their calcium carbonate differs among taxa, and likely so does their sensitivity to carbon chemistry perturbations. This working group is dedicated to compare calcifying organisms and integrate knowledge on the basic mechanisms that are responsible for CaCO₃ precipitation and the implications for the global carbon export.

Aliani summarized the proposal and its reviews. Some reviewers found the proposed working group to be very timely given the ongoing acidification of the oceans by anthropogenic carbon dioxide, which will affect calcification rates and also have implications for the potential marine carbon dioxide removal method of ocean alkalinity enhancement. However, reviewers pointed

out that there are many studies focused on synthesis, review, and meta-analyses of calcification in marine invertebrates (e.g., <https://doi.org/10.3389/fmars.2021.584445>, <https://doi.org/10.1002/sml.202107407>, <https://doi.org/10.1016/j.envres.2023.116019>). Despite that, reviewers agreed that there are still gaps in understanding the complexity of calcification, but did not all agree that the working group would be poised to make further progress without additional research, which is outside the scope of a SCOR working group.

Several reviews found the ToRs too optimistic given the complexities related to potential long-term adaptation strategies of organisms, differences in responses across life stages, and the role of multiple stressors. Reviewers found ToR 3 to be important but more appropriate as a laboratory task, and the proposal did not explain how the working group did not describe well how the working group would make progress as a result of their discussions on the topic. The proposal was described as important but very ambitious by several reviews, particularly the addition of ToR 4—testing the efficiency of ocean alkalinity enhancement mitigation measures—on top of the other ToRs.

Several reviews noted that developing-country scientists are only represented on the associate membership, and some should be moved to full members to guarantee their involvement and travel support. One review suggested the proposal consider additional mechanisms of engagement to aid knowledge exchange between SWITCH and the wider ocean carbon cycle modeling community.

The proposal received 3 Must Fund 13 May Fund, and 3 Do Not Fund ratings. It was not selected for funding.

2.1.12. TRACE element SAMplers and sensORS, A step change to observing and understanding trace metal biogeochemistry in the ocean (TRACEAMORS)

Abstract: The availability of essential trace metals (Fe, Zn, Co, Cu, Mn) controls primary productivity in up to half of the world's oceans and modulates the ecological framework of different ocean biomes. One of the biggest remaining challenges to improving our understanding of ocean biogeochemistry is the availability of accurate in situ techniques for the determination of the concentration and speciation of these essential trace metals. Our present understanding is constrained by limited temporal and spatial resolution observations, especially during critical seasonal and event-driven transitions in remote areas of the oceans. This is due to the absence of sensors that are suitably sensitive, selective and robust to determine elements at extremely low concentrations. Hence, the proposed topic will initiate international collaborations to foster the application and development of new samplers and sensors, for the determination of trace metal concentrations and speciation in specific parts of the ocean. The workgroup builds on the work of Grand et al. (2019) [1] OceanObs'19 paper recommendations on the creation of an

international working group of trace metal sensor developers. Following a recent international meeting (TRACEAMORS, Brest 2022), our working group will focus on evaluating key analytical challenges with existing oceanographic sensors for trace metal analysis, review emerging sensing technologies in other disciplines and their potential for oceanographic use, and provide recommendations for inter-comparison with current remote samplers (target zones, deployment, maintenance). The aim is to promote collaborative international research to instigate a step change in our ability to monitor trace metal dynamics.

Croot summarized the proposal and its reviews. Most reviews considered the proposal to be covering an important topic. The rapid growth of BGC-Argo and AUVs is lowering the cost of autonomous platforms and making access for other sensors more attractive and there is a window of opportunity now to harness this opportunity and ensure that other key ocean parameters are also able to make this leap to new platforms. However, not all reviews agreed that enough previous studies exist to make intercomparisons amongst sensors and techniques and evaluate global applications of the technologies. Reviewers recognized the technologies had continued to mature since the prior proposal, however still expressed concerns that the working group is premature. As new technologies continue to develop, the intercomparison by the working group could become out of date. Reviews stated that the proposal could be improved by providing more concrete approaches/linkages for objective 3 (identifying new technologies from other fields) by, for example, including working group members from other fields with promising techniques.

Reviewers did not find the membership to be well balanced in terms of gender; this is better with the incorporation of associate members but better balance in the full membership, who are guaranteed travel support, would ensure balanced participation by gender. Reviewers thought the membership included a diverse set of countries, including developing countries. However, members from South America are not included and reviewers thought it would be interesting to consider countries in the southeast Pacific, where one of the most important zones of the Eastern Boundary Upwelling Systems (EBUS) is located, which could be a key area for trace metal measurements using in situ sensors.

The proposal received 4 Must Fund, 11 May Fund, and 4 Do Not Fund ratings. It was not selected for funding.

Discussion

Twigg presented the summary of scores of each working group proposal. There was a clear division separating the ratings for 4D-BGC and NEMOO from the remaining proposal scores. These two were recommended for funding. The attendees discussed the possibility of funding a third proposal. It was agreed that it would be beneficial to fund a third proposal if committees could agree on a choice. GLUBS and FIERCE had the same average score in third place. After deliberation, it was suggested by Croot that GLUBS could be funded in order to further support

the goals of IQOE, which is a SCOR project with a low level of funding. National committee representatives agreed to this and GLUBS was recommended for funding.

Attendees asked about policies for the number of times a proposal could be submitted and whether proponents are explicitly invited to resubmit. The Executive Committee noted that it had been discussed during their executive meeting and there is no limit, particularly given that a proposal should be considered new each time and would be expected to have changed to some degree. Each proposed working group receives a letter that summarizes the reviews; the letter does not encourage or discourage resubmission. Pre-screening the proposals was also discussed. Specifically, there is a word count limit that does not appear to always be enforced. The executive director will enforce proposal formatting requirements when possible.

2.2. Current Working Groups

A designated member of each working group and project or its liaison on the Executive Committee presented an update on activities, limited to 10 minutes including time for questions. In the case of working groups, Executive Committee liaisons made recommendations for continued funding, disbanding, or other actions to be taken.

2.2.1. WG 148. International Quality Controlled Ocean Database: Subsurface temperature profiles (IQuOD)

Lijing Cheng made a remote presentation for WG 148. IQuOD is in its tenth year and continues to develop, implement, and document new techniques to provide an unbiased climate dataset of the highest quality, consistency, and completeness. The community has developed a machine learning approach for the assignment of “intelligent” metadata for XBT (Expendable Bathythermograph) data and assigned the uncertainty for each individual measurement (Haddad et al., 2022, <https://doi.org/10.1175/JTECH-D-21-0117.1>). The group has also evaluated the most effective combination of automated quality control (AutoQC) procedures for temperature profile observations (Good et al., 2023, <https://doi.org/10.3389/fmars.2022.1075510>). With these developments, the group has freely disseminated an interim version of the IQuOD global temperature profile database through the National Centers for Environmental Information at the National Oceanographic and Atmospheric Administration (NOAA). IQuOD has been very active holding an online meeting every month, and has established collaboration with the OceanTeacher Global Academy (OTGA). An in-person meeting was organized on 10-11 July in Potsdam, Germany and the steering team has discussed and decided the main activities for the following 1-2 years. This includes a pilot activity on salinity quality control. IQuOD request the use of their remaining funds on a publication fee. The members will continue to work together on the salinity quality control aspect, which extends beyond the terms of reference and available funding of the SCOR working group. SCOR monitor Van Haren agreed the working group could

continue under the SCOR umbrella while they completed their work on salinity, despite the absence of remaining funds.⁴

2.2.2. WG 150. Translation of Optical Measurements into particle Content, Aggregation & Transfer (TOMCAT)

Cheah, executive reporter for WG 150, reported that the working group had nothing further to report from the year. As reported at the 2022 SCOR annual meeting, the working group had made plans to hold a summer school in South Africa but for various reasons it was unable to materialize and thus no activities were conducted in the reporting period. The working group is now disbanded.

2.2.3. WG 151. Iron Model Intercomparison Project (FeMIP)

Co-Chair Alessandro Tagliabue reported on the working group's final activities. In the last calendar year, WG 151 has focused on finalizing its last task on ToR 4 – assembling knowledge on how biological processes around the ocean iron cycle are represented in ocean models. A publication is forthcoming. Tagliabue stated that this was the final year for the working group. However, the community remains active, such as through GEOTRACES. The working group is now disbanded.

2.2.4. WG 152. Measuring Essential Climate Variables in Sea Ice (ECV-Ice)

François Fripiat reported on the activities of WG 152. The working group met in person in March (San Diego, USA) with additional virtual meetings in 2023, which was its final year. In total, the working group completed seven inter-comparison experiments, mostly in Japan, but also in Canada and the Roland von Glasow sea ice chamber at the University of East Anglia (UK). Two peer-reviewed journal articles were published in the reporting period. The working group has started to create a guide of best practices for biological and biogeochemical studies (ToR 4) hosted on the ECV-Ice website as a living document. The first entry will be the Miller et al. (2015, <https://doi.org/10.12952/journal.elementa.000038>) methodological review from SCOR WG 140 Biogeochemical Exchange Processes at the Sea-Ice Interfaces (BEPSII), and the results of additional methods evaluations and intercalibrations will be added, as they become available. The working group will disband after the SCOR meeting.

⁴ Subsequent to the SCOR annual meeting, the working group determined it would end its term as a SCOR working group upon release of their upcoming publication.

2.2.5. WG 153. Floating Litter and its Oceanic Transport Analysis and Modelling (FLOTSAM)

Working group Chair Aliani reported for WG 153 FLOTSAM. The working group's focus was to identify gaps in knowledge of ocean dynamics that may affect litter distribution and transport; to improve modeling capabilities; to evaluate existing and emerging remote sensing (RS) technologies and to improve people's awareness of marine debris. These objectives have been accomplished, including highly cited papers and the development of new approaches in modeling. The WG's new perspectives in RS fostered dedicated funding programs from space agencies and innovative RS methodological guidelines (publication in prep) and establishment of the IOCCG Remote Sensing of Marine Litter and Debris Task Force. Maximenko et al., (2018, <https://www.frontiersin.org/articles/10.3389/fmars.2019.00447/full>) highlighted the urgent need of a global observing system for marine litter, which led to the development of the Integrated Marine Debris Observing System (IMDOS). Startup meetings in this direction have been carried out and other actions are ongoing. IMDOS will be a major legacy as well as an ECOP (Early Career Ocean Professionals) network resulting from a dedicated workshop. FLOTSAM is also contributing to the UN Environment Programme (UNEP) Intergovernmental Negotiating Committee on Plastic Pollution. The remaining SCOR funds will be used for participation in activities of IMDOS and UNEP, after which the working group will be disbanded.

2.2.6. WG 155. Eastern boundary upwelling systems (EBUS): diversity, coupled dynamics and sensitivity to climate change

Co-Chair Ruben Escribano reported on the progress of WG 155. The working group has been slowly making progress towards ToRs. From the second half of 2021 until September 2022, much time and effort was devoted to planning and organizing the EBUS Open Science Conference held in Lima, Peru in September 2022. Five members of WG 155 were part of the organizing committee of the conference. Along with the conference, several members of the WG also met in person for a half day. The meeting was mostly dedicated to discussion on the review paper. Recently published works and new information recommended updating the focus of the review and including additional analyses. The paper is at its final stage and is expected to be ready for submission soon. The working group has also made progress in updating the website data source. A Special Issue is being prepared for the Journal Deep Sea Research Part II as a result of the Lima conference. Intended submissions were proposed by mid December 2022 and there is a list of about 80 potential manuscripts. The reviewing process is ongoing and expected to be completed by May 2024. A summer school for 2023 was canceled but some members are participating in the GOOD-OARS-CLOP-COPAS 2023 Summer School in November 2023.

Participants at the SCOR meeting expressed concern that the data portal (ToR 2) has limited information and that the review paper (ToR 3) has not been submitted after several years. Escribano noted copyright issues related to posting published data in their portal. The SCOR

Executive Committee will discuss addressing the slow progress of the working group’s final products.

2.2.7. WG 156. Active Chlorophyll fluorescence for autonomous measurements of global marine primary productivity

WG 156 provided a recorded update by working group member Nina Schuback on their activities. The working group’s activities focused on comparison and calibration of active fluorometers. WG 156 is in its final reporting phase, with a major outcome being submission of the best practices document (*Application of Single Turnover Active Chlorophyll Fluorescence for Phytoplankton Productivity Measurements*), which captured many elements of the original scope of work proposed. Members are continuing data collection and dissemination activities that will contribute to a longer legacy of the terms of reference. This includes Schuback’s participation in a SCOR Visiting Scholar knowledge exchange, where she visited Aurea Ciotti at CEBIMAR (Centro de Biologia Marinha), University of São Paulo, Brazil along with associate member Ilana Berman-Frank. The working group is now disbanding.

2.2.8. WG 157. Toward a new global view of marine zooplankton biodiversity based on DNA metabarcoding and reference DNA sequence databases (MetaZooGene)

WG 157 provided a recorded update by Chair Ann Bucklin on their activities. The focus of the working group is on 8,000+ species of holoplankton (15 phyla, 32 classes) with a goal of integrative molecular-morphological taxonomic analysis of marine zooplankton diversity throughout the global ocean through DNA metabarcoding. Planning and cooperation among working group 157 members was carried out through email, virtual meetings, and an online collaboration space, with topic-related folders for sharing files and preparing documents and manuscripts. The working group created the MetaZooGene Atlas & Database (ToR 1), which contains over 300,000 COI gene sequences for about 20,000 species. The MetaZooGene Atlas and Database Web page: <https://metazoogene.org/mz gdb> now includes zooplankton, benthic invertebrates, fish, marine mammals, and phytoplankton (aka microbes and protists). A book chapter with detailed instructions for using the Atlas & Database was accepted for publication in 2023 (O’Brien et al., 2023. *Protocols for DNA Barcoding, Methods, in Molecular Biology*, Springer Nature). Since 2020, the WG has produced 13 publications that acknowledge SCOR. The working group was endorsed as a UN Ocean Decade Action in 2022 in association with Marine Life 2030.

WG 157 sponsored a symposium “New insights into biodiversity, biogeography, ecology, and evolution of marine zooplankton based on molecular approaches,” in association with the ICES Annual Science Conference (Hybrid; Dublin, Ireland; September 23, 2022). Working group

member Mary Mar N. Payne (University of the Philippines) was hosted by member Junya Hirai (University of Tokyo, Japan) for a collaborative research visit during March 24 – April 15, 2023. Support was provided by the SCOR 2022 Exceptional Call for Visiting Scholars. Results from the project, “Preliminary assessment of zooplankton biodiversity in Batan and Tangalan Bays (Aklan, Philippines) using DNA metabarcoding,” are being prepared for publication. Working group member Jenny Huggett convened and participated in meetings (both in-person and virtual) during 2023 to discuss implementation of DNA metabarcoding as a routine method for monitoring the marine environment in South Africa (see Huggett et al. 2022). At the Western Indian Ocean Marine Science Symposium (Gqeberha, South Africa; October 2022), collaborative meetings with UN Ocean Decade representatives sought to develop metabarcoding capacity throughout the Western Indian Ocean region.

2024 is expected to be the final year for the working group, during which they will conduct the MetaZooGene Intercalibration Experiment and hold sessions/workshops and their annual meeting at the ICES-PICES International Zooplankton Production Symposium 7. Future activities may continue under ICES. The working group was approved to continue their activities with SCOR support.

2.2.9. WG 158. Coordinated Global Research Assessment of Seagrass System (C-GRASS)

WG 158 provided a recorded update by Chair Emmett Duffy on their activities. The vision of C-GRASS is to develop a picture of status and trends of seagrasses and develop a community of practice. The working group held an in-person workshop coordinated with the International Seagrass Biology Workshop 14 (ISBW) and World Seagrass Association in Annapolis, USA in August 2023. The group has made progress on a draft manuscript developing and promoting specifications for the GOOS seagrass cover and composition Essential Ocean Variable (ToR 2), and an associated data schema (ToR 3). A second manuscript is in progress comparing seagrass dynamics based on remotely sensed data with those based on in situ data (ToR objective 1). Informal gatherings brought several members of the group together to discuss seagrass coordination at the World Conference on Marine Biodiversity in Malaysia in July 2023; and the community of practice plans to have a final working group meeting at ISBW 15 in Napoli, Italy in June 2024 focused on ToR 4.

2.2.10. WG 159. Roadmap for a Standardised Global Approach to Deep-Sea Biology for the Decade of Ocean Science for Sustainable Development (DeepSeaDecade)

WG 159 Chair Ana Hilário provided a presentation on the working group’s activities. The principle aim of this working group was to deliver an overarching plan that formed the basis of

deep-sea biological research for the next decade. That plan was developed and delivered at the start of the UN Ocean Decade in the form of a peer reviewed publication (Howell et al., 2020, <https://doi.org/10.3389/fmars.2020.584861>). This publication formed the basis of an application to the IOC to endorse a new UN Ocean Decade Action “Challenger 150.” The SCOR working group then served as the steering committee of that program, establishing the program, building a long-term management structure, and continuing to address the working group ToRs through that program. This year sees the final year of the SCOR working group, and as such the group has formally handed over its role as steering committee to the new management structure for Challenger 150. In addition, the group has focused its efforts on ToR 5: to actively facilitate efforts to build capacity in developing nations for deep-sea science. The working group held a workshop in South Africa to develop a plan for capacity building in deep sea research in Africa. The working group has disbanded and will continue future activities as the Challenger 150 Programme.

2.2.11. WG 160. Analysing ocean turbulence observations to quantify mixing (ATOMIX)

WG 160 Co-Chair Cynthia Bluteau provided a recorded presentation on the working group’s activities and was available to answer questions. The focus of the working group is on developing algorithms for turbulent kinetic energy dissipation, relevant for estimating distribution of heat, salt, nutrients, etc. Over the last 12 months, the ATOMIX working group met virtually on a regular basis to fulfil their ToRs. Notable advancements in the last 12 months include: (1) Producing benchmark datasets which are available on the wiki. (2) Testing of the benchmark datasets by members of the working groups. Results of this ongoing exercise are guiding refinements in the best practice flow charts and quality-control indicators and flags. (3) Drafting of best practices manuscripts to describe benchmarks and processing steps. (4) Brainstorming and collating existing materials for teaching core principles of processing turbulence analysis to develop capacity in estimating mixing. The working group will eventually have a GitHub page for downloading simple tools for using benchmark datasets. Some progress on the benchmarking testing was delayed into 2023, and thus the best practices are delayed from 2023 to 2024. The working group will try to make up time in the next year and SCOR will continue to support the working group. Van Haren stated that epsilon doesn't provide diffusivity for understanding nutrient transport. Bluteau replied that it can along with information on the background gradients, which the working group is providing some guidance on regarding time and length scales over which the background should be calculated.

2.2.12. WG 161. Respiration in the Mesopelagic Ocean (ReMO): Reconciling ecological, biogeochemical and model estimates

WG 161 Co-Chair Carol Robinson provided an update on the working group's activities. The working group held 10 online meetings at approximately monthly intervals between June 2022 and June 2023, in addition to focused subgroup meetings to progress particular deliverables. The monthly meetings include a seminar which is recorded and made available via the website and YouTube channel (<https://www.remo-scor-wg161.com/about-3>). Their mentoring scheme continues (<https://www.remo-scor-wg161.com/copy-of-home>) and discussions within the working group have contributed to two review papers published in Annual Review of Marine Science (Herndl et al., 2023, <https://doi.org/10.1146/annurev-marine-032122-115655> and Iversen, 2023, <https://doi.org/10.1146/annurev-marine-032122-035153>). Robinson described the working group's efforts to develop a global dataset with MicroRespire funded by the Natural Environmental Research Council. The plan is to make the dataset publicly available. The working group conducted a 6-day training course in Las Palmas, Gran Canaria for 10 international early-career researchers in person and another 29 students online. This involved hands-on practical experience with methods used to measure mesopelagic respiration, seminars on using BGC-Argo data, calculating AOU (apparent oxygen utilization) budgets, and using models in addition to 8 lectures. The course instructors included 12 members of the working group and 4 members of the research teams of the working group members. Lecture recordings, the Argo data seminar, and the AOU budget seminar are available online (<https://www.remo-scorwg161.com/about-8>). WG 161 requested to continue for two more years to accommodate delays from COVID-19. SCOR monitor Judith Gobin agreed to the request.

2.2.13. WG 162. Developing an Observing Air-Sea Interactions Strategy (OASIS)

WG 162 provided a recorded presentation by Co-Chair Sebastiaan Swart on the working group's activities. The working group has completed ToR 1 by publishing a synthesis of the recommendations from over forty OceanObs19 community white papers. The recommendations have harmonized into three grand ideas: (1) expand the air-sea observation network, (2) optimize satellites for air-sea fluxes, and (3) improved models of understanding of air-sea interaction process. A Theory of Change requiring working globally, across disciplines, and following FAIR principles underlies their grand ideas. Progress has continued on the other ToRs through regular telecons and webinars attended by a broader OASIS community. The UN Ocean Decade has endorsed three projects under the auspices of the UN OASIS Decade Program. These are a regional coupled atmosphere-ocean model, Southern Ocean Flux Capability Working Group (SOFLUX, led by SOOS), and the Uncrewed Surface Vehicle Network for GOOS. In Feb 2024, OASIS is organizing a face-to-face meeting prior to the Ocean Sciences Meeting in New Orleans, USA. The working group expects to continue for one more year. SCOR monitor Peeken recommended continued support from SCOR.

2.2.14. WG 163. Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (CIce2Clouds)

WG 163 Co-Chair Nadja Steiner provided an update on the working group's activities. CIce2Clouds has been actively working on the five ToRs through online meetings and will next meet during the SOLAS Open Science Conference in Goa, India in November 2024. A key goal of CIce2Clouds is to improve communication and understanding among ocean, sea-ice, and atmospheric scientists with respect to the exchange processes between interfaces and their impacts on clouds in the polar regions. Hence, a key output is a series of tutorial talks and a tutorial-style review paper to bridge knowledge gaps among communities. The tutorial material targets both early-career researchers and senior scientists with expertise in only one of the domains. Throughout the first meetings, tutorial talks have been developed and recorded to share via the CIce2Clouds website. Based on the content of those talks, a manuscript is in preparation. In addition, discussions in the three CIce2Clouds subgroups (sulfur cycle, nitrogen cycle, primary aerosols) have evolved to develop coupled conceptual models, considering both poles as well as different seasons. Manuscripts to describe these conceptual models are now in preparation. Early-career researchers have been significantly involved in the sulfur cycle working group. The working group has connected with WG 166 regarding sulfur cycling. SCOR monitor Croot recommended SCOR continue its support of the working group.

2.2.15. WG 164. CoNCENSUS: Advancing standardisation of COastal and Nearshore demersal fish visual CENSUS techniques

WG 164 Co-Chair Anthony Bernard provided a recorded presentation about the working group's activities. Over the last year the working group has focused on advancing ToR 3 (data management) and ToR 4 (research field mapping). The working group's initial review of available data to address ToR 1 led to the decision that more existing datasets needed to be sourced, processed, and incorporated into the analysis. The current community engagement processes from ToR 4 are directly contributing towards additional data acquisition. ToR 2 is dependent on further progress on ToR 4. A working group meeting was held in Hobart, Australia in January 2023 following the International Temperate Reef Symposium. The meeting was attended by four CoNCENSUS members, a guest researcher, and one early-career researcher. The meeting focused on advancing the data management system (ToR 3) and resulted in the production of a draft proposal and workflow for the system. For ToR 4, the working group has completed a comprehensive (1,475 documents) bibliometric analysis of the nearshore fish visual census field research landscape, employing epistemic methods and the online platform, Cortext (publication in progress). The results highlight how the underwater visual census research field has grown over the last 70 years in terms of research topics, sampling methods and global participation. This analysis will form the basis of a questionnaire survey. To strengthen the global community of practice, the working group provided training to researchers from Namibia, South Africa, Comoros, Seychelles, Maldives, and India through a combination of field

expeditions and workshops. The working group provided feedback to the GOOS BioEco panel on the progress of the working group and its role in advancing the development of EOVs and implementation plans. The working group has obtained funding to support two postdocs to work on the ToRs and deliverables in 2024.

2.2.16. WG 165. Mixotrophy in the Oceans – Novel Experimental designs and Tools for a new trophic paradigm (MixONET)

WG 165 Co-Chair George McManus delivered a presentation about the working group's activities. MixONET entered the second year in January 2023. Major highlights include publication of the first ever comprehensive mixoplankton database (available in Zenodo) (ToR 1) and delivery of a special session, "The New Paradigm Testing the Resilience of Our Science in the UN Ocean Decade," at the ASLO Aquatic Sciences meeting 2023. Santoferrara (USA) was awarded a grant from the "Exceptional" Call for SCOR Visiting Scholars to work with Fernando Unrein (Argentina). Santoferrara's 12-day visit to Argentina included laboratory work at the INTECH institute and the UNNOBA University, both in the province Buenos Aires, a talk for the INTECH Waters research group, and knowledge exchange with graduate students. The goal of the project was to design and test a methodology to isolate and identify nano-mixoplankton, using a combination of feeding experiments, flow cytometry and DNA metabarcoding (ToRs 2 and 3). Several experiments were carried out between February and March 2023. The mixoplankton were successfully quantified, sorted, and sequenced, obtaining promising results. As part the ocean literacy and capacity building aspirations of MixONET (ToR 4) Santoferrara delivered a 'Mixoplankton' module within the 2-week "Marine Microbiology and Biogeochemistry" OTGA course in Spanish, while Mitra (UK) hosted a POGO-SCOR Fellow, Sangeeta Naik (India), for 8 weeks from 30 January 2023. SCOR monitor Peeken asked about their progress on low-cost monitoring. It was noted that expert identification is still a limiting factor. Peeken recommended continued support from SCOR.

2.2.17. WG 166. Developing resources for the study of Methylated Sulfur compound cycling PROCesses in the ocean (DMS-PRO)

WG 166 Co-Chair Martí Galí Tàpias provided a presentation on the working group's activities. DMS-PRO initiated its activities in January 2023. During this initial period, the group has deployed a strategy to work effectively towards its objectives by (1) creating four thematic teams, (2) setting up internal communication and online collaboration platforms, and (3) trying to establish a regular meeting schedule within each team. The four teams are Standard Operating Procedures, Database, Communication & Outreach, and Funding & Endorsement. Each team has 2-3 coordinators, and coordination among teams is ensured by the co-chairs and by the participation of each member in more than one team. According to the work plan, the group has placed efforts on the core ToRs (1-3), which include the elaboration of a Standard Operating

Procedures document and the creation of a database for methylated sulfur cycling rate measurements. The public will be asked to contribute to the database once it has undergone internal testing. The report submitted in advance of the meeting stated that some members had not been well engaged. Galí noted that the core group of members is well engaged, and they are working on addressing remaining issues. SCOR monitor Peeken recommended continued support.

2.2.18. WG 167. Reducing Uncertainty in Soluble aerosol Trace Element Deposition (RUSTED)

WG 167 Co-Chair Morgane Perron provided a presentation on the working group's activities. RUSTED was established in October 2022. Much of RUSTED's initial activities have focused on introducing their goals and establishing collaborative links with the scientific community. Additionally, the groundwork for outputs including a literature review of aerosol leaching methods, the aerosol database, and a RUSTED Special Issue are underway. The working group is seeking a partner and funding sources for their database. Two virtual and two hybrid meetings for all members, plus three co-chair meetings have been held since October 2022. The working group held a meeting and hosted a session at the ASLO Aquatic Sciences Meeting in Palma de Mallorca, Spain. The working group is pursuing work under the following topics: inter-comparison, database, capacity building, literature review, and modeling. SCOR monitor Sicre asked about the working group's reference to developing a statement about iron fertilization for climate mitigation and requested the working group involve SCOR in this. Perron clarified they would act as knowledge provider to international groups requesting information and had not decided if they would pursue this as a working group. Croot advised that a SCOR working group not make their own statement and SCOR may pursue whether there should be a policy.

3. Large-Scale Ocean Research Projects Reports

3.1. GEOTRACES – Marine Biogeochemical Cycles of Trace Elements and Isotopes

GEOTRACES Co-Chair Karen Casciotti delivered a presentation about the project's activities. The GEOTRACES field program progressed with 144 cruises completed, corresponding to 38 GEOTRACES sections (with 50 cruises), 41 process studies (with 65 cruises), 18 compliant

datasets, as well as 11 cruises completed as a GEOTRACES contribution to the International Polar Year (IPY). During the past year (1 May 2022 to 30 April 2023), 3 new section cruises from Japan, Germany, and USA and 3 process studies (1 from Australia, 1 from Germany (with 2 cruises) and 1 from USA) have been undertaken. In addition, 5 new compliant datasets have been endorsed. GEOTRACES has released three Intermediate Data Products (IDPs). A new version of the GEOTRACES IDP 2021 was released in July 2023. The IDP ensures data by GEOTRACES follows FAIR principles. Data tools are available at geotraces.org and subset extraction of data is possible via web tools. The next IDP is planned for release in November 2025. GEOTRACES Education (GTED) has produced seven videos with graphic designer Adrian Artis, available on youtube and youku. Video tutorials were also produced during the 2022 summer school and a 360-degree virtual sailing experience is in development. GEOTRACES is an endorsed action of the UN Ocean Decade.

3.2. SOLAS – Surface Ocean – Lower Atmosphere Study

Li Li, SOLAS executive director, started the presentation by reviewing recent activities of SOLAS. Co-Chairs Minhan Dai and Cecile Guieu will conclude their terms at the end of 2023. SOLAS established its future committee, the Early Career Scientist Committee (ECSC), in January 2023. Seven events have been organized or are being planned by the committee. SOLAS also established regional panels in southeast Asia and Latin America. SOLAS launched several initiatives to further boost its science including on the topics of wildfire, eddy covariance, Earth system modeling, and marine carbon dioxide removal. SOLAS is organizing a Special Feature in *Elementa* on the “Air-Sea Interface in a Changing Climate.” The 9th SOLAS Summer School took place in Mindelo on Cape Verde, 5-15 June 2023, which was organized by an alumni-dominated organizing committee. The school hosted 66 students from 25 countries who had a chance to interact with 30 lecturers. Moreover, SOLAS and the University of Galway, Ireland, initiated the first run of the new Research Master of Science on Ocean, Atmosphere, and Climate in September 2022. It will run in its second round starting September 2023. The SOLAS Open Science Conference is upcoming in Goa, India on 10-14 November 2024.

Next, SOLAS Co-Chair Cecile Guieu, described the strategic planning for the third decadal SOLAS science plan. A planning workshop was held in September 2023 in Xiamen, China. The next decade would tentatively cover “science to solutions” through three themes: discovery science, science for solutions, and community and skill development, with feedbacks among the themes. Social sciences would be included as a cross-cutting activity over all themes. The plan is to have a draft plan completed by November 2023, with comments by the scoping workshop participants in December, and finalization in late 2024.

3.3. IMBeR – Integrated Marine Biosphere Research

John Claydon, IMBeR executive director, provided an update on IMBeR’s activities. 2025 will mark the end of IMBeR’s second 10-year term. The restrictions on activities that IMBeR experienced in previous years due to COVID-19 were largely absent in 2022-2023, with in-person meetings, research cruises, and field work being more feasible over the period of this report. IMBeR was able to make progress towards achieving the objectives of the Grand Challenges and Innovation Challenges, with a focus on the interdisciplinary human-ocean system. IMBeR is looking for a new IPO host for when the agreement with Dalhousie University ends at the end of March 2024. IMBeR is also seeking a new chair or co-chairs. Claydon provided examples of publications making key contributions to the Grand Challenges, Innovation Challenges, regional programs, and working groups. Claydon also highlighted the Action Plan for the Ocean, which is meant to identify risks to the ocean and develop actions to address them. IMBeR convened its 8th International ClimEco Summer School (ClimEco8) in Koper, Slovenia, which was endorsed by the UN Ocean Decade. The summer school was attended by 46 marine science students, postdocs, and early-career researchers from 22 countries, and expanded participation into new geographic areas. Sponsorship was secured to support the attendance of 19 participants. The 2023 ESSAS Annual Science Meeting was held as a hybrid meeting in June in Bergen, Norway. The sessions had strong links to Grand Challenge 1, Innovation Challenge 5, and Innovation Challenge 6. IMBeR’s Interdisciplinary Marine Early Career Network (IMECaN) held a virtual workshop on 11 October 2022, that addressed Diversity, Equity, and Inclusion in interdisciplinary marine research. Planned future events are the IMBIZO7 in September 2024 (Morocco) and the Future Oceans 3 conference in March 2025 (Colombia).

3.4. IQOE – International Quiet Ocean Experiment

Peter Tyack, co-chair of the IQOE science committee (SC), provided an update on recent activities. The SC met on 26–27 April 2023, in Woods Hole, Massachusetts, USA. All 10 SC members participated either in person or remotely. Tyack reviewed recent progress and ongoing activities for IQOE. A metadata database of ocean sound observations since 1999 now includes over 5,000 records. The metadata database shows that pelagic areas and the Southern Ocean are under sampled. The *Ocean Sound Essential Ocean Variable Implementation Plan* was published in September 2023. GLUBS, a working group of IQOE, hired a post-doc with funds from the Lounsbery Foundation and conducted a workshop in April 2023. Tyack shared a diagram of how GLUBS will be structured for sound collection and AI analysis. Other activities include an activity to synthesize observations of the impacts of the COVID-19 pandemic on ocean sound, a task team formed to create specifications for low-cost hydrophones for education and citizen science, World Ocean Passive Acoustic Monitoring (WOPAM) Day, and an acoustics fellow to work with the Comprehensive Test Ban Treaty Organization on ocean acoustic data.

Van Haren asked about capabilities for deep-sea sensors since low-cost hydrophones for citizen science would be surface based. Tyack noted that the Comprehensive Test Ban sensors are in some deep-sea locations, but further planning is needed.

3.5. IIOE-2 – International Indian Ocean Expedition 2

Sicre, IIOE-2 Co-Chair representing SCOR, provided an update on recent activities. The IIOE-2 Core Group is composed of the three co-chairs and the co-chairs of three working groups. WG-1 has been promoting the development of synthesis papers and special issues focused on the Indian Ocean. WG-1 is also involved in supporting the efforts of IIOE-2 WG-2 (Data and Information Management). WG-2 is charged with early sharing of data using internationally agreed rules of data exchange. WG-3 is charged with developing and integrating web-based tools, databases, and partnerships to enable a sufficient level of cooperation, resource-sharing, scientific collaboration, and capacity alignment. After two years of meeting online, a meeting was held in person in Perth, Australia at the Indian Ocean Marine Research Centre (IOMRC), University of Western Australia (UWA) 6-7 February 2023. Following the IIOE-2 SC-6 meeting were the meetings of the IndOOS Resource Forum (IRF) (15th major meeting), SIBER (13th major meeting), IORP (18th major meeting), IOGOOS (18th major meeting), and KUDOS Workshop as part of the International Indian Ocean Science Conference (IIOESC-2023).

IIOE-2 has currently endorsed 80 projects involving 20 countries. Research initiatives are underway on Eastern Indian Ocean Upwelling and Western Indian Ocean Upwelling as well as cruises under the Years of the Maritime Continent. IIOE-2 has six research themes, and two have been inactive and are seeking new chairs to be reinvigorated. Eighteen official IIOE-2 cruises have been conducted thus far. COVID-19 led to the RAMA (Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction) array going offline, but it is expected that resumed cruises will soon return 70% of the array online. Regarding synthesis efforts, a book of 20 chapters on the Indian Ocean is under development. IIOE-2 also produces the Indian Ocean Bubble twice per year and a monthly newsletter. The website includes a metadata and data portal and expedition updates. The IIOE-2 science plan is intended to end in 2025. The IIOE-2 SSC will meet at INCOIS in Hyderabad, 28-30 November 2023 to discuss the Future Road Map for IIOE-2.

Sicre offered to provide contacts for the IIOE-2 data manager when asked about the inclusion of cruises from programs like GEOTRACES and GO-SHIP.

4. Infrastructural Projects Reports

4.1. SOOS – Southern Ocean Observing System

Irene Schloss, SOOS vice-chair, provided an update on SOOS activities. In 2022, two major documents were finalized, approved, and published: the SOOS Science and Implementation Plan (2021-2025) and the SOOS 5-Year Report (2016-2020). Production of these documents was led by the SOOS IPO and benefitted from support and input from across the SOOS community. In addition to these publications, 2022 also saw the publication of the SOOS Data Policy, which was a significant contribution from the SOOS Data Management Sub-Committee (DMSC). Two SOOS-focused peer-reviewed publications were published in 2022: LaRue et al. (2022, <https://doi.org/10.1111/conl.12884>) showed the latest results from the Capability Working Group on Censusing Animal Populations from Space (CAPS) and Beadling et al. (2022, https://ametsoc.net/sotc2021/StateoftheClimate2021_lowres.pdf) provided the 2021 update for the State of the Climate Report from the Bulletin of the American Meteorological Society (BAMS). The Southern Ocean Action Plan for the UN Ocean Decade, for which SOOS is a key partner alongside many other Southern Ocean-focused stakeholder organizations, was also produced in 2022. The Marine Ecosystem Assessment for the Southern Ocean (MEASO) produced a Summary for Policymakers, available the day of the presentation at the SCOR meeting. The first SOOS Symposium was held August 2023 in Hobart, Australia. The program included 12 parallel presentations including four panel discussions and early-career researcher (ECR) perspectives, 17 parallel sessions and four parallel workshops, five lunch meetings, a poster session, a trade exhibition, a data helpdesk, a dinner, and an ECR networking event. The symposium concluded with a statement on the importance of Southern Ocean science. SOOS is planning for activities at COP28.

4.2. IOCCP – International Ocean Carbon Coordination Project

IOCCP Director Maciej Telszewski gave a presentation on IOCCP's activities. In the past 12 months, IOCCP continued to support the development of a global network of ocean carbon and biogeochemistry observations, coordinate the development of globally acceptable strategies and provide technical coordination developing operating methodologies, practices and standards, homogenizing efforts of the research community and scientific advisory groups. Telszewski highlighted concerns regarding significant decline in our capacity to make the ever-more demanded ocean CO₂ observations. For example, the key data synthesis product SOCAT, lost one of two nodes, has funding shortfalls, and requires IT modernization. During the discussion,

Sicre noted that the G7 had recommended re-establishment of SOCAT's European node and a long-term plan for interoperability between global ARGO, SOCAT, and GLODAP. Telszewski described the value chain from ocean data collection to policy making, the components of which, he said, need to work together to minimize mitigation and adaptation costs. Current IOCCP efforts are focused on helping the community to operationalize the value chain of surface ocean CO₂ measurements. Telszewski also highlighted the vulnerability of production, distribution and certification of the ocean carbonate system Reference Materials and efforts by multiple groups to increase the resilience through the creation of 3 globally distributed regional hubs. IOCCP contributed to the development of IMDOS by coordinating a complex landscape of participating bodies. IOCCP—with co-sponsorship of the EU ICOS Ocean Thematic Center, the National Oceanic and Atmospheric Administration (USA), the Ocean Frontiers Institute (Canada), and the Carbon to Sea Initiative (USA)—held the 3rd edition of the "Instrumenting our ocean for better observation: a training course on a suite of biogeochemical sensors." Lastly, Telszewski commented on the potential for an economic valuation of the Framework for Ocean Observing, and posed the question of what the role could be for SCOR.

4.3. COBS – Changing Ocean Biological Systems

Sinead Collins, COBS co-chair, provided a recorded update on COBS' activities. Revisions to the COBS membership were the selections of Sam Dupont as a new co-chair and Stephanie Dutkiewicz, Miriam Seifert, and Cristian Vargas joined as new members. COBS is built around five cross-linked teams. Each team developed a position analysis that was discussed at the general meeting in spring 2023. Toward progress on their ToRs, MEDDLE (<https://meddle-scor149.org/>)-based workshops and training materials continue to be delivered through a national advocates network. COBS members have published peer-reviewed scientific papers that explore the logic behind using specific experimental designs (e.g., full factorial) to develop generalizable theoretical underpinnings for phytoplankton responses to two or more drivers to explore the statistical power of different multidriver experimental designs. To disseminate the challenges and opportunities surrounding multiple drivers and ecosystems, members have focused on papers on experimental design or are undertaking exercises that reach out to specific communities by either bringing together early-career researchers in multi-driver research or reaching out to self-contained communities such as coral reef researchers. In the future, COBS is planning joint activities with IMBeR Innovation Challenge 4. Collins also described the activities of the new model group who are developing a position document on whether ocean acidification should be included in Earth system models, developing a "model explainer," and developing a road map for empirically determining key model parameters needed to move models to the ecosystem level with multiple drivers over long time scales.

4.4. GlobalHAB – Global Harmful Algal Blooms

Elisa Berdalet, outgoing chair of GlobalHAB, provided an update on their recent activities. The GlobalHAB SSC held monthly virtual meetings and email communications since the last in-person meeting in Glasgow, Scotland, UK in 13-14 May 2022. The third partial renewal of the SSC was completed in September 2023, including selection of Clarissa Anderson (USA) as new chair. Several members of the GlobalHAB SSC (Elisa Berdalet, Dave Clarke, Bengt Karlson, Marc Suddleson, and Maggie Broadwater) participated as authors in the joint technical guidance for the implementation of early warning systems for harmful algal blooms (<https://doi.org/10.4060/cc4794en>). GlobalHAB, in collaboration with GESAMP and the EuroSea European project, is working on the elaboration of a white paper on current fundamental scientific understanding of Sargassum population dynamics and research gaps to complement the UNEP “SARGASSUM WHITE PAPER: Turning the crisis into an opportunity.” In November 2023, GlobalHAB is hosting an in-person workshop in Hiroshima, Japan to foster the integration and the application qPCR/dPCR methodologies to improve HAB monitoring and to develop early risk alert systems, after a series of four virtual workshops. The “GlobalHAB International Workshop on Solutions to Control HABs in Marine and Estuarine Waters” will be held within the PICES Annual Meeting in October 2023. A white paper on Fish-Killing Algal Blooms and Ichthyotoxins: Prevention, Mitigation and Control is now under revision, and it will be presented at the International Conference on Harmful Algae. GlobalHAB is a partner to HAB-Solutions Programme, which has been proposed for endorsement by the UN Ocean Decade by the IOC-FAO Intergovernmental Panel on Harmful Algae Blooms (IPHAB). The SSC will consider plans for GlobalHAB after the conclusion of the science plan in 2025, which will be focused on contributions to HAB-S.

4.5. JCS – Joint Committee on Seawater (IAPWS/SCOR/IAPSO)

Rich Pawlowicz, chair of JCS, provided an update on the project. JCS serves as a point of contact and source of expertise for the seawater community and is responsible for products and tools such as TEOS-10. No in-person meetings of JCS occurred over the past year. A planned JCS virtual meeting for January 2023 was postponed. However, the proposed membership of the new Chemical Speciation Taskgroup has been finalized and they have been holding monthly virtual meetings as part of software finalization from the completion of SCOR WG 145 MARCHEMSPEC, and the development of a website containing that software (marchemspec.org). A draft JCS website, separate from <http://www.teos-10.org/>, has been completed, with plans to “go live” once arrangements for hosting and the provision of a suitable domain name have been finalized. Van Haren asked how they track usage of TEOS-10 and if it should be promoted more. Pawlowicz said this could be revisited when they revise the ToR.

5. Affiliated Organizations

Affiliated Project Reports

5.1. IOCCG – International Ocean Colour Co-ordinating Group

Raisha Lovindeer, IOCCG project coordinator, provided an update on IOCCG, which has been an affiliated project of SCOR since 1997, and is an associate member of the Committee on Earth Observation Satellites (CEOS). Venetia Stuart retired as project coordinator on 1 January 2023. Committee members of the IOCCG are representatives from space agencies around the world as well as from the ocean color research community. IOCCG promotes development and applications of science and technology that underpin remote sensing of ocean color across all aquatic environments, including in-land, coastal, and open-ocean. This occurs through coordination; training; liaison between providers (the space agencies) and users (scientists and professionals); advocacy; and provision of expert advice. This mandate is advanced through IOCCG working groups and task forces, as well as the CEOS Ocean Colour Radiometry-Virtual Constellation (OCR-VC). For the next two years, the focus of the OCR-VC will be the development of an Aquatic Carbon Roadmap to support the Global Stocktake within CEOS. The OCR-VC will also contribute to the development of the Aquatic Reflectance Product Family Specification for CEOS Analysis-Ready Data (ARD). IOCCG initiated two new working groups on ocean primary production and classification of optical water types in aquatic radiometry. IOCCG also initiated two new task forces: Ocean Carbon from Space and Hyperspectral Remote Sensing of the Ocean. The IOCCG Protocol Series produced *Ocean Optics & Biogeochemistry Protocols for Satellite Ocean Colour Sensor Validation*. Over the next three years, new protocol documents are anticipated that will focus on phytoplankton taxonomy and imaging, and on carbon. The Inaugural IOCCG Trevor Platt Memorial Scholarship was launched, which provides USD \$5k to a scholar from a developing country for research or training up to 3 months in another country.

5.2. InterRidge – International RIDGE Studies

Cheah shared the update from InterRidge. After 3 years of lockdown under COVID-19, things were starting to look up in early 2023. On February 28, 2023, an online Steering Committee Meeting was held. China expressed interest in hosting the InterRidge office for the next 3 years in Shenzhen. However, many young scientists expressed that reform of InterRidge is needed before seeking to solicit applications for the next InterRidge office. ‘Reform first’ was agreed

upon by most members of the Steering Committee. An extension was given to the InterRidge Office in Korea until the end of the year (December 31, 2023). It was also agreed that a face-to-face meeting was needed for the Steering Committee members. As a result, the first offline meeting since the global pandemic will be held at Seoul National University in Korea 25-27 September. Some of the items that will be discussed during the September Steering Committee meeting include (1) reforming the governance of InterRidge (in particular, whether to separate the science and operation of InterRidge or not), (2) codifying InterRidge regulations into written text, (3) making a regular InterRidge Conference every 2 years, (4) drafting of The Next Decadal Plan (2024-2033), and other eminent issues. On June 8-9, a workshop on the Indian Ocean was held in Shenzhen, China, hosted by Jian Lin. On August 14-18, the 7th International Symposium on Chemosynthesis-Based Ecosystems (CBE7) will be held in San Paulo, Brazil.

5.3. GACS – Global Alliance of Continuous Plankton Recorders

GACS was unable to provide a written report or presentation to SCOR.

Affiliated Organization Reports

5.4. IABO – International Association for Biological Oceanography

IABO President and SCOR Executive Committee member Judith Gobin provided an updated on IABO. During this performance cycle, IABO activities focused on these key areas: (1) organization of the 6th World Conference on Marine Biodiversity (VI WCMB) held in Penang, Malaysia, on July 2-5 of 2023; (2) reviewing of SCOR working group proposals; (3) full implementation of the PeerJ-IABO Hub; (4) selection of the 2022 Carlo Heip awardee; and (5) IABO President elections for the 2024-2026 cycle. The selected candidate for the 2022 Carlo Heip Award was Prof. Angelika Brandt. The award ceremony was carried out at the VI WCMB in Penang, Malaysia, during IABO's General Assembly. The IABO President and Secretary General positions were up for renewal in 2023 and the new leadership was appointed during the General Assembly at the VI WCMB conference in Penang, Malaysia, on 5 July. The elected candidate for the Presidency was Prof. Judith Gobin from The University of the West Indies in Trinidad and Tobago, who now serves as ex-officio on the SCOR Executive Committee. The Association launched the IABO Hub (<https://peerj.com/hubs/iabo>) on December 21st of 2022 in partnership with PeerJ Publishing Group to facilitate publication of peer-reviewed articles from the IABO community on PeerJ's open-access journals with APC discounts and full fee waivers for selected countries. The launch of the IABO Hub has resulted in the growth of the

Association's membership, promoting IABO announcements (e.g., Carlo Heip Excellence Award notifications, WCMB conferences, community workshops), and the collection of funding in the form of tokens that can be used toward publishing fees of submissions from registered IABO members from developing and least developed nations. The Editorial Board of the Hub is composed of members of the IABO Executive Committee and Task Groups to ensure that manuscripts submitted to this platform are reviewed by the IABO community.

5.5. IAPSO – International Association for the Physical Sciences of the Oceans

Van Haren provided the updates for IAPSO. IAPSO has the prime goal of “promoting the study of scientific problems relating to the oceans and the interactions taking place at the sea floor, coastal, and atmospheric boundaries insofar as such research is conducted by the use of mathematics, physics, and chemistry.” IAPSO works mainly through (1) biennial scientific assemblies; (2) working groups; (3) commissions; (4) services; and (5) website information. Of special importance to IAPSO is the involvement of early-career scientists as well as those from least-developed countries. IAPSO maintains formal liaison with other scientific commissions and committees. These include the SCOR and IOC. The IAPSO Bureau was renewed in July 2023 during the IUGG (International Union of Geodesy and Geophysics) General Assembly in Berlin. The new president, Van Haren (the Netherlands) now serves as ex-officio on SCOR's Executive Committee. IAPSO's current activities include the Joint (SCOR/IAPSO/IAPWS) Committee on Seawater, the Tsunami Commission, the Permanent Service for Mean Sea Level, the Joint (IAPSO/IACS) Commission of Ice-Ocean Interactions, and the IAPSO Early Career Scientist Working Group. Since 2019, IAPSO has also sponsored two Best Practice Study Groups every two years. The four current groups are on the topics of moored yoyo-CTD, pH sensors, tidal analysis, and mapping ocean heat content. Three awards were presented by IAPSO at the 2023 IUGG meeting: (1) The Prince Albert I Medal to Prof. John Church (Australia), (2) the Early Career Scientist Medal to Dr. Malte Stuecker (Germany/USA), and (3) Eugene LaFond Medal to Prof. Helenice Vital (Brazil).

5.6. IAMAS – International Association of Meteorology and Atmospheric Sciences

Outgoing IAMAS President Joyce Penner provided a recorded presentation for IAMAS. IAMAS selected a new Bureau for 2023-2027. Andrea Flossmann (Germany) now serves as president and ex-officio member of the SCOR Executive Committee. The IAMAS Early Career Scientist Medal was presented to Cheng Sun in 2023 for his significant contributions in the area of atmosphere-ocean interaction and climate dynamics. IAMAS has 10 different commissions,

which hold their own meetings every four years and meet with IAMAS and IUGG in other years. IAMAS operates under a strategic plan adopted in 2019.

6. Intergovernmental and Partner Organizations

Intergovernmental Organizations Reports

6.1. IOC – Intergovernmental Oceanographic Commission

Sicre, SCOR reporter and vice-chair for IOC, summarized the activities of IOC described in their annual report to SCOR. SCOR is historically a partner and strategic mechanism for the IOC to increase capacity to address critical ocean science issues for which the IOC Secretariat does not have resources, mandate, or human capacity to address alone and where, not the least, better and more valuable knowledge products can be delivered by joint activities. SCOR-IOC collaboration has both proven a valuable mechanism to address longer-term research themes (programs) as well as more targeted and time bound tasks (working groups). The most substantial collaboration currently is GlobalHAB which is coming to the end of its current ToRs. The IOC-FAO IPHAB requested the IOC-SCOR GlobalHAB Scientific Steering Committee to: (i) review the GlobalHAB Science and Implementation Plan with a view to present to IPHAB-XVII (in 2025) what it recommends as the main elements of an international HAB research program after 2025 focusing on understanding HABs in the context of global sustainability; (ii) assess the ideal organization of and partnerships for such an international research program after 2025; (iii) recommend to IPHAB-XVII whether an international HAB research program after 2025 should be as a continuation under the name GlobalHAB or under a new name. GlobalHAB is currently engaged in the development and implementation of a co-designed UN Ocean Decade program, the HAB Solutions Programme (HAB-S), to deliver solutions to sustainably provide safe seafood, drinking water and ensure healthy coastal socio-ecosystems. HAB-S would provide a wider context for a potential GlobalHAB or equivalent program after 2025.

Sicre reminded everyone that there is a new call for UN Ocean Decade actions, with a strong focus on capacity building, particularly in Caribbean and African nations.

6.2. PICES – North Pacific Marine Science Organization

Sanae Chiba provided a recorded presentation about PICES' activities and was on the Zoom line to answer questions. PICES is composed of five member nations and belongs to Smart Net, a UN Ocean Decade program to establish a global knowledge network for ocean science. Between the PICES and ICES networks, it covers much of the northern hemisphere. PICES has been expanding the network into the southern hemisphere. Under Smart Net, PICES/ICES joint expert groups contribute to thematic priority topics. Communication and capacity building initiatives contribute to cross-cutting themes. PICES seeks further partnerships through SCOR's network. PICES has partnered with SCOR on capacity development and has a representative on SCOR's Capacity Development Committee. SCOR and PICES support capacity development at each other's scientific events. SCOR has provided support to one PICES conference in 2021, one PICES conference in 2023, with commitment to support the 7th International Zooplankton Symposium in 2024. PICES, in turn, has supported summer schools of SCOR projects. SCOR also provided support to a session and workshop organized by the PICES Expert Group: Section on Ecology of Harmful Algae Blook in the North Pacific (S-HAB). The PICES annual meeting is upcoming on 23-27 October 2023 in Seattle, USA. The meeting will engage local indigenous leaders.

6.3. GESAMP WG 38 – The atmospheric input of chemicals to the oceans

Co-Chair Timothy Jickells provided an update about the GESAMP WG 38 activities. During the past year GESAMP WG 38 has focused its attention on the following four areas: (1) Completion of a workshop in South Africa, "Potential role of atmospheric deposition in driving ocean productivity in the Southwest Indian Ocean," and the development of paper(s) from that workshop; (2) Completion of a Summary for Policymakers for GESAMP Reports and Studies No. 109, "The Changing Acidity of the Global Atmosphere and Ocean and its Impact on Air/Sea Chemical Exchange;" (3) Began work on a GESAMP Reports and Studies document on the joint WG 38/40 workshop the atmospheric transport of microplastics to and from the ocean; and (4) Organized a session on air/sea chemical exchange at the 2023 European Geosciences Union meeting. The workshop, held in Gqeberha (Port Elizabeth), South Africa from 4-7 October 2022, aimed to understand the drivers of blooms, which affect food security in an important fisheries region. The workshop included capacity building for early career researchers on the first day and discussions with policy makers on the final day. Van Haren asked if atmosphere was considered the only driver of deposition in the western Indian Ocean or were land and oceanographic inputs also included. Inputs from land were noted as a likely final trigger but not the only source of inputs.

Partner Organizations Reports

6.4. POGO – Partnership for Observation of the Global Ocean

Lilian Krug provided an update on POGO's activities. POGO is composed of 55 members from 30 countries. Krug described activities under the three pillars of POGO: Innovation in Ocean Observing, Capacity Development, and Outreach & Advocacy. POGO supports innovation in ocean observing through partnerships and establishes working groups, special sessions, and projects. POGO and SCOR both sponsor IQOE. POGO funded a working group to support the IQOE, which was instrumental in getting the Ocean Sound EOY accepted by GOOS. This year, POGO supported IQOE's development of the Implementation Plan for the Ocean Sound EOY. POGO also contributed to the establishment of SOOS and provided support with SCOR for early-career scientists at the SOOS Symposium. For capacity development, SCOR and POGO co-sponsor the POGO-SCOR Fellowship Programme. POGO also runs the NF-POGO Centre of Excellence program for training in developing countries. This year, POGO became an endorsed UN Ocean Decade Implementing Partner. Organizations can become involved with POGO by becoming a member, becoming an Ocean Training Partner, and contributing to Oceanscape (oceanscape.org). The 25th annual meeting will be held in Mexico in January 2024.

Aliani asked if there is any training on observations of plastics and global harmonization of methods. Krug noted that they have citizen science projects in six African countries and Malaysia using a Standard Operating Procedure for sampling that can be done by students and teachers. Sicre asked if POGO was linked to any Category 2 training centers for students and technicians (in India, Iran, and Iceland) from IOC-UNESCO. Krug said POGO is not and would look more into them.

6.5. ISC – International Science Council

Martin Visbeck provided a presentation about ISC, of which SCOR is an affiliated body. The vision of ISC is to advance science as a global public good. The mission is to be the global voice for science. ISC is increasingly engaging in global policy progress, by representing science in initiative such as the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction, IOC/UNESCO, the United Nations Framework Convention on Climate Change (UNFCCC), the New Urban Agenda, and the Convention on Biological Diversity (CBD). SCOR provides relevance for ISC in ocean sciences areas such as UN Sustainable Development Goal 14. The ISC is guided by its current Action Plan (2022-2024) with a focus on global sustainability, converging science and technology in a digital era, science in policy and public discourse, changing practices in science and science systems, and freedom and responsibility in science. The recent report, *Flipping the Science Model: A Roadmap to Science Missions for Sustainability*, highlights the need for transformative science for sustainability, such as the science motivated by the UN Ocean Decade. Relevant to SCOR, ISC co-sponsors the

International Polar Year (IPY) 2032-2033 organized by the International Arctic Science Committee and SCAR. ISC will showcase SCOR and other member work at COP 28. A high-level meeting will be held by ISC with affiliated bodies and co-sponsors in March 2024 in order to engage more externally.

Sicre asked how ISC planned to work with affiliated bodies. Visbeck stated that ISC hoped to increase engagement compared to the last few years starting with the meeting in March 2024. Sicre also asked about ISC's inclusion of Pacific Small Island Developing States. Visbeck stated that work is underway to encourage them to become a member of ISC, and that there is the potential for development of a Pacific Islands Academy of Sciences.

6.6. SCAR – Scientific Committee on Antarctic Research

Eoghan Griffin provided a presentation for SCAR. The mission of SCAR is to advance research in, from, and about Antarctica and the Southern Ocean, and to promote scientific knowledge, understanding and education on any aspect of the Antarctic and Southern Ocean regions. SCAR is a cosponsor with SCOR of SOOS. The first SOOS Symposium took place in August 2023, bringing together 300 researchers from 25 countries, on the theme of “Southern Ocean in a Changing World.” A joint statement delivered at the end of the symposium emphasized the point that a chronic lack of observations in the Southern Ocean challenges our ability to detect change. Following the publication of the Southern Ocean Action Plan in April 2022, SCAR was approved to act as the Decade Collaborative Centre for the Southern Ocean Region (DCC-SOR) on World Oceans Day, 8 June 2023. SCAR is contributing to the UNFCCC COP28 Cryosphere Pavilion, led by the International Climate Cryosphere Initiative (ICCI), to promote Antarctic and Southern Ocean research. Additionally, more details are coming soon about plans for the IPY 2032-2033.

Peeken asked if the 2027-2030 synchronous observations (Antarctica InSync) would be related to the IPY. Griffin explained that Antarctica InSync, which would coordinate national programs and be a UN Ocean Decade thematic program, will be part of the setup for the IPY. Tagliabue asked if SCAR was connecting with modeling groups. Griffin noted there is a group looking at improving model projections using high resolution data sets and better representation of physical processes and contribute to CMIP.

6.7. Future Earth and the Ocean Knowledge Action Network

Stella Alexandroff provided an update about Future Earth and the Ocean Knowledge Action Network (Ocean KAN). Ocean KAN brings networks together to share knowledge among those working to co-design ocean science and knowledge for sustainable development. Ocean KAN

focuses on regional action and leadership. Ocean KAN focuses on building trust and relationships between its regional partners, UN Ocean Decade-endorsed programs, international networks, universities, and private sector partners. The first Ocean KAN in-person meeting was held in March 2023 to further develop the governance structure. Highlights for the last year include: a special issue in the ICES Journal of Marine Sciences, a new International Panel on Ocean Sustainability (led by Ocean KAN members), mentoring and judging of the Ocean Hackathon in Malaysia, a keynote speech at the Ocean Hackathon Grand Finale (France), and the co-creation of a workshop on science storytelling with partners from the Seychelles, and the Western Indian Ocean Early Career Scientists Network.

Van Haren asked for examples of issues the Ocean KAN network is tackling. They depend on the region, for example indigenous leadership in developing marine protected areas in the South Pacific, or small-scale fisheries. Van Haren asked if they are meant to link the coasts to the open ocean, which they are not.

Future Earth is a network of scientists, researchers, and innovators designed to provide the knowledge needed to support transformations towards sustainability. Their focus on systems-based approaches seeks to deepen our understanding of complex Earth systems and human dynamics across different disciplines and use this understanding to underpin evidence-based policies and strategies for sustainable development. Future Earth has participated in or coordinated several ocean-related events at the UNFCCC COP27 in Sharm el Sheik. Additionally, Future Earth was represented at CBD COP15 in Montréal, the Intergovernmental Panel on Climate Change (IPCC) 58 session, the Bonn Climate Change Conference, the UNFCCC Subsidiary Body for Scientific and Technological Advice, the IPCC 10 in Bonn, and the IPCC meeting in Nairobi. In March 2023, Future Earth actively contributed to the UN Water Conference by sending a delegation, and participating in side events. A joint statement was submitted by members of the Earth Commission and Sustainable Water Futures.

6.8. WCRP – World Climate Research Programme / CLIVAR

Hindumathi Palanisamy provided a recorded presentation about WCRP/CLIVAR activities. Palanisamy emphasized that the message is clear that the Earth is warming, surpassing records for ocean temperatures and reductions in sea ice. WCRP leads the way in addressing frontier scientific questions related to the coupled climate system—questions that are too large and too complex to be tackled by a single nation, agency, or scientific discipline. Through international science coordination and partnerships, WCRP contributes to advancing our understanding of the multi-scale dynamic interactions between natural and social systems that affect climate. WCRP engages productively through these partnerships to inform the development of policies and services and to promote science education.

Currently, WCRP is in the process of implementing its new research strategy (WCRP Strategic Plan 2019-2028). One objective of the science plan is to bridge climate science and society, along with the three science objectives. Major elements of the Science and Implementation Plan are to strengthen support for core research, ensure engagement of the next generation of scientists and improve the diversity of WCRP leaders (across nations, regions, and disciplines), deepen their interaction with partners at national and international levels, and ensure that society has the climate knowledge that it needs for decision-making. The WCRP Joint Scientific Committee is composed of international experts in physical science and social science. WCRP has several core projects, and CLIVAR is the one that focuses on ocean-atmospheric interactions. Two new projects are ESMO (Earth System Modelling and Observations) and RifS (Regional Information for Society). About 10% of the leadership in steering groups are early-career scientists. WCRP also has “Lighthouse” activities—short-term activities on pressing topics to produce robust, actionable information. Two new Lighthouse projects are the Global Precipitation Experiment (GPEX) and the Science of Climate Intervention (CI). CLIVAR addresses different research foci lasting 3-5 years. Recently they have initiated focuses on marine heatwaves and on tropical basin interactions.

The WCRP Open Science Conference (<https://www.wcrpclimate.org/wcrp-osc23>) will be 23-27 October 2023 in Kigali, Rwanda, which will bring together more than 1,400 participants both virtually and on-site from diverse research communities, programs, and partners to discuss the latest developments in climate science, with an emphasis on science-based information for decision making.

7. Capacity-Development Activities

Capacity development activities are described in the presentations by Zitoun from the SCOR Capacity Development Committee and Krug from POGO. Additionally, a report on the 2022 POGO-SCOR Fellowship program can be found at the following link: https://scor-int.org/wp-content/uploads/2023/09/POGO-SCOR-Fellowships_2022_Report.pdf.

8. SCOR Organization

8.1. Membership

Twigg noted changes to nominated members since the last annual meeting. On the Chilean National Committee, Teniente Matías Sifón Andalaft replaced Harald Urbina Córdova. Jacopo Chiggiato was appointed to fill the position left by Annalisa Griffa on the Italian National Committee. Charlotte Laufkötter replaced Kurt Hanselman on the Swiss National Committee. National committees should alert SCOR to changes of nominated members.

8.2. Publications Arising from SCOR Activities

During her presentation on Day 1, Twigg reported that altogether, SCOR projects and working groups produced 50 publications in the 2022-2023 period that acknowledge SCOR. Eighteen of the publications were by WGs, 9 of which included early-career scientists as co-authors. Proper SCOR acknowledgement when deserved is an ongoing topic that is continuously reminded to the projects and working groups. While there is no standardized definition of what a “SCOR publication” is for the different projects, the need of acknowledging the sponsorship is critical for reporting metrics to SCOR’s funders (e.g., NSF). All working group publications are updated on the SCOR website (<https://scor-int.org/work/publications/>).

9. SCOR-Related Meetings

Dejun Dai, a representative from the China-Beijing SCOR National Committee, provided information for the 2024 SCOR Annual Meeting in Qingdao. The meeting will be held 16-18 October. A conference exhibition in recognition of the 40th anniversary of the National Committee will be held on 15 October. The hosting national committee is composed of 25 members who meet annually.

Yoo informed meeting participants that the 2025 annual meeting will be hosted by the Colombian National Committee. He invited national committees to consider hosting in 2026.

See locations of past SCOR meetings at the SCOR website: <https://scor-int.org/events/category/annual/>.

Summary of recommendations and close of general meeting

Yoo summarized the outcomes of the meeting. The finance committee found SCOR to be in a good financial state. Three working group proposals were selected for funding: 4D-BGC, NEMOO, and GLUBS. Upon approval by the SCOR Executive Committee, they will begin in 2024. The SCOR Executive Director will provide comments to all submitted working group

proposal proponents. SCOR's 18 active working groups reported on their progress and most are progressing well. Six are expected to disband (WG 150 TOMCAT, WG 151 FeMIP, WG 152 ECV-Ice, WG 153 FLOTSAM, WG 156 Chlorophyll Fluorescence, WG 159 DeepSeaDecade). SCOR is continuing to uphold fundamental scientific research but is supporting the UN Ocean Decade. Partner organizations are also making substantial progress.

Yoo thanked INOCAR for their assistance in organizing the annual meeting in Ecuador this year. Nominated member from Leonor Vera returned the thanks to SCOR for visiting Ecuador.

Yoo closed the general portion of the annual meeting.

Appendices

Appendix 1. Participants of the SCOR 2023 Annual Meeting

Participants – SCOR Executive and Secretariat

Sinjae Yoo	South Korea
Marie-Alexandrine Sicre	France
Peter Croot	Ireland
Stefano Aliani	Italy
Brad Moran	USA
Ilka Peeken*	Germany
Judith Gobin	Trinidad and Tobago
Hans van Haren	Netherlands
Wee Cheah	Malaysia
Jacqueline Uku*	Kenya
Emily Twigg	USA

Participants – Nominated Members

Fatima Abrantes*	Portugal
Göran Björk*	Sweden
Marcela Cornejo	Chile
Dan Costa*	USA
Naomi Harada	Japan
Toshiyuki Hibiya*	Japan
Ana Hilario*	Portugal
Chan Joo Jang	South Korea
Andrey Kostianoy*	Russia
Charlotte Laufkötter	Switzerland
Paul Myers*	Canada
Katja Peijnenburg*	Netherlands
Constanza Ricuarte Villota	Colombia
Adam Sokołowski*	Poland
Alessandro Tagliabue	UK
Petteri Uotila	Finland
Leonor Vera	Ecuador

Jing Zhang

Japan

Participants – Other

Sheuly Akter*	Bangladesh
Stella Alexandroff*	France
Jesse Ausubel*	USA
Elisa Berdalet*	Spain
Cynthia Bluteau*	Canada
Eduardo Briones	Ecuador
Mihai Burca*	Italy
Maritza Cárdenas	Ecuador
Karen Casciotti*	USA
Gui Castelao*	USA
Lijing Cheng*	China
Sanae Chiba*	Canada
John Claydon*	Canada
Dejun Dai	China
Daniela del Valle*	Argentina
Simon Elise*	Reunion (France)
Natalia Erazo	USA
Ruben Escribano*	Chile
Elvis Espinoza*	Ecuador
Juan Fierro	Chile
Francois Fripiat*	Belgium
Marti Gali Tapias*	Spain
Rafael González	Ecuador
Eoghan Griffin*	UK
Cécile Guieu*	France
Akinori Ito*	Japan
Tim Jickells*	UK
Maria Jose Marin Jarrin*	Ecuador
Evgeniia Kostianaia*	Russia
Iris Kriest*	Germany
Lilian Krug*	Portugal
Ann-Katrien Lescrauwaet *	Belgium
Li Li	China
Raisha Lovindeer*	Canada
Angela M. Kuhn*	USA

Dra. Maria Elena Tapia*	Ecuador
Elena Masferrer*	France
George McManus*	USA
Tina Mertens*	Belgium
Christine Meyzen*	Italy
Kevin Mindiola Reyes	Ecuador
David Moncayo	Ecuador
Zulfatun Naimah*	France
Todd O'Brien*	USA
Rich Pawlowicz*	Canada
Linwood Pendleton*	France
Morgane Perron*	France
Jacqueline Rivas*	Ecuador
Carol Robinson*	United Kingdom
Irene Schloss*	Argentina
Nadja Steiner*	Canada
Maciej Telszewski*	Poland
Gladys Torres*	Ecuador
Peter Tyack*	USA
Ed Urban*	USA
Martin Visbeck*	Germany
Rebecca Zitoun*	Germany
Fang Zuo*	China

*Remote attendees

Appendix 2. Agenda

Block Agenda

	Mon, 16 October	Tues, 17 October	Wed, 18 October	Thurs, 19 October
AM	SCOR Executive Committee Closed Meeting	Opening of 2023 meeting: Reports from SCOR President, SCOR Executive Director, SCOR Capacity Development Committee, ad hoc Finance Committee	Reports from current SCOR Working Groups and projects (remote presenters)	Reports from SCOR Partner Organizations Meeting Summary
PM	SCOR INOCAR Symposium on Marine Sciences in Ecuador	Discussion of new working group proposals Reports from affiliated organizations	Reports from current SCOR Working Groups and projects (remote, in person, and recorded presenters) Reports from Affiliated Projects	SCOR Executive Committee Closed Meeting

SCOR Annual Meeting Day 1. Tuesday, 17 October 2023.

Chair: Sinjae Yoo / Note taker: Peter Croot

Time	Topic	Presenter
9:00	Welcome and introduction to agenda In Memoriam	Yoo
9:15	Report from SCOR President	Yoo
9:30	Report from SCOR Executive Director	Twigg
9:45	Report from SCOR Capacity Development Committee	Zitoun
10:00	Report from the SCOR ad hoc Finance Committee	Myers
10:15	<i>Presentation of new Working Group proposals:</i> Each presentation will be 10 minutes , plus time for questions (3-5 minutes) following each presentation. Coordinating the Development of Gridded Four-Dimensional Data Products from Biogeochemical-Argo Observations (4D-BGC) Assessing Microplastic Impacts & Transport in Upwelling Systems (AMITUS)	Cheah Peeken
10:45	BREAK (30 minutes)	
11:15	<i>Presentation of new Working Group proposals, Continued:</i> Data Insight through the Value of Eco-marine-robotics (DIVE) Foraminifera in Extreme and Rapidly Changing Environments (FIERCE) Fine-scale near-surface stratification in the Polar Oceans (FINESS) Global Library of Underwater Biological Sounds (GLUBS) Towards best practices for Measuring and Archiving Stable Isotopes in Seawater (MASIS) Monitoring Ocean Health: Assessing the global state and trend in phytoplankton biomass and biodiversity (MOHealth 2024) NEw physiological Metrics for Oceanography from ‘Omics (NEMOO)	Moran Sicre Aliani Moran Croot Gobin Yoo
13:00	LUNCH (60 minutes)	
14:00	<i>Presentation of new Working Group proposals, Continued:</i> Oceanic Salt Intrusion into Tidal Freshwater Rivers (SALTWATER) Studying Worldwide Impacts of Calcification Trends on CHanging Climate (SWITCH) TRACE element SAMplers and sensORS, A step change to observing and understanding trace metal biogeochemistry in the ocean (TRACESAMORS)	van Haren Aliani Croot
14:45	<i>Ranking and discussion of new Working Group proposals</i>	SCOR Executive and National Committees
15:30	BREAK (30 minutes)	

16:00	<i>Ranking and discussion of new Working Group proposals, Continued</i>	
16:30	<i>Affiliated organizations reports (Part 1)</i> IABO – Biological Oceanography IAPSO – Physical Oceanography IAMAS – Meteorology and Atmosphere	Gobin van Haren Penner (Recording)
17:00	Adjourn for the day	

SCOR Annual Meeting Day 2. Wednesday, 18 October 2023.

Chair: Sinjae Yoo / Note taker: Peter Croot

Time	Topic	Presenter / EC liaison
9:00	Introduction to Day 2 session WG and project presentations will be 5-8 minutes , followed by time for questions following each presentation and comments/recommendations by EC liaison.	Yoo
9:10	<i>Group 1. Presenters joining remotely from Asia</i> WG 148 IQuOD	Cheng/van Haren
9:20	<i>Group 2. Presenters joining remotely from Europe</i> GEOTRACES – Trace elements and isotopes IMBeR – Integrated Marine Biosphere Research SOLAS – Surface Ocean-Lower Atmosphere Study GlobalHAB – Global Harmful Algal Blooms IOCCP – International Ocean Carbon Coordination Project	Casciotti/Croot Claydon/Aliani Guieu/Flossmann Berdalet/Yoo Telszewski/Moran
10:30	BREAK (30 Minutes)	
11:00	<i>Group 2. Presenters joining remotely from Europe, Continued</i> WG 152 ECV-Ice WG 159 DeepSeaDecade WG 161 ReMO WG 166 DMS-PRO WG 167 RUSTED	Fripiat/van Haren Hilario/Gobin Robinson/Gobin Galí Tàpias & del Valle/Peeken Perron/Sicre
12:00	<i>Group 3. Presenters joining remotely from North and South America</i> SOOS – Southern Ocean Observing System IQOE – International Quiet Ocean Experiment JCS – Joint Committee on Seawater	Schloss /Cheah Tyack/Uku Pawlowicz/van Haren

	WG 155 EBUS WG 165 MixONET	Escribano/Sicre McManus/Peeken
13:00	LUNCH	
14:00	Group 3. Presenters joining remotely from North and South America, Continued WG 163 CIce2Clouds WG 157 MetaZooGene WG 160 ATOMIX	Steiner & Willis/Croot Recording (O'Brien)/Gobin Recording (Bluteau)/van Haren
14:30	Group 4. Recorded presentations COBS – Changing Ocean Biological Systems WG 156 Chlorophyll Fluorescence WG 158 C-GRASS WG 162 OASIS WG 164 ConCENSUS	Recording/Yoo Recording/Uku Recording/Aliani Recording/Peeken Recording/Gobin
15:15	BREAK (30 Minutes)	
15:45	Group 5. Presenters on site (EC liaison or attending member) IIOE-2 – Second International Indian Ocean Expedition WG 150 TOMCAT WG 151 FeMIP WG 153 FLOTSAM	Sicre Cheah Tagliabue/Moran Aliani/Peeken
16:30	Affiliated Projects IOCCG InterRidge	Lovindeer/Yoo Lee/Cheah
17:00	Adjourn for the day	

SCOR Annual Meeting Day 3. Thursday, 19 October 2022.

Chair: Sinjae Yoo / Note taker: Peter Croot

Time (am)	Topic	Presenter / EC liaison
9:00	Introduction to Day 3 session Presentations will be 5-8 minutes , plus time (~2-5 minutes) for questions following each presentation and comments/recommendations by EC liaison.	Yoo
9:10	<i>Partner organization updates</i> IOC – Intergovernmental Oceanographic Commission GESAMP WG 38 – Atmospheric Input of Chemicals to the Oceans POGO – Partnership for Observation of the Global Ocean SCAR – Scientific Committee Antarctic Research Future Earth-OceanKAN PICES - North Pacific Marine Science Organization WCRP / CLIVAR – World Climate Research Program ISC – International Science Council	Sicre Jickells /Aliani Krug /Aliani Griffin /Peeken Alexandroff /Twig Recorded (Chiba) /Moran Recorded /Flossmann Visbeck /Sicre
10:30	BREAK (15 minutes)	
10:45	<i>Partner organization updates, Continued</i>	
11:00	Future SCOR meetings: <ul style="list-style-type: none"> ● Qingdao, China 2024 ● Colombia 2025 ● Host for 2026? 	Open discussion
11:15	Summary of recommendations and close of general meeting	Yoo
12:00	LUNCH (60 minutes)	
13:00	SCOR closed Executive Committee meeting	Executive Committee

Appendix 3. Links to Working Group Proposals

- 2.1.1. **4D-BGC**: Coordinating the Development of Gridded Four-Dimensional Data Products from Biogeochemical-Argo Observations [[Proposal](#)]
- 2.1.2. Assessing Microplastic Impacts & Transport in Upwelling Systems (**AMITUS**) [[Proposal](#)]
- 2.1.3. Data Insight through the Value of Eco-marine-robotics (**DIVE**) [[Proposal](#)]
- 2.1.4. Foraminifera in Extreme and Rapidly Changing Environments (**FIERCE**) [[Proposal](#)]
- 2.1.5. Fine-scale near-surface stratification in the Polar Oceans (**FINESS**) [[Proposal](#)]
- 2.1.6. Global Library of Underwater Biological Sounds (**GLUBS**) [[Proposal](#)]
- 2.1.7. Towards best practices for Measuring and Archiving Stable Isotopes in Seawater (**MASIS**) [[Proposal](#)]
- 2.1.8. Monitoring Ocean Health: Assessing the global state and trend in phytoplankton biomass and biodiversity (**MOHealth 2024**) [[Proposal](#)]
- 2.1.9. NEw physiological Metrics for Oceanography from ‘Omics (**NEMOO**) [[Proposal](#)]
- 2.1.10. Oceanic Salt Intrusion into Tidal Freshwater Rivers (**SALTWATER**) [[Proposal](#)]
- 2.1.11. Studying Worldwide Impacts of Calcification Trends on CHanging Climate (**SWITCH**) [[Proposal](#)]
- 2.1.12. TRACE element SAMplers and sensORS, A step change to observing and understanding trace metal biogeochemistry in the ocean (**TRACEAMORS**) [[Proposal](#)]

Appendix 4. Links to Working Group Reports

- 2.2.1. WG 148. International Quality Controlled Ocean Database: Subsurface temperature profiles (**IQuOD**) [[Report](#)][[Slides](#)]
- 2.2.2. WG 150. Translation of Optical Measurements into particle Content, Aggregation & Transfer (**TOMCAT**) [[Report](#)]
- 2.2.3. WG 151. Iron Model Intercomparison Project (**FeMIP**) [[Report](#)][[Slides](#)]
- 2.2.4. WG 152. Measuring Essential Climate Variables in Sea Ice (**ECV-Ice**) [[Report](#)][[Slides](#)]
- 2.2.5. WG 153. Floating Litter and its Oceanic TranSport Analysis and Modelling (**FLOTSAM**) [[Report](#)][[Slides](#)]
- 2.2.6. WG 155. Eastern boundary upwelling systems (**EBUS**): diversity, coupled dynamics and sensitivity to climate change [[Report](#)][[Slides](#)]
- 2.2.7. WG 156. Active **Chlorophyll fluorescence** for autonomous measurements of global marine primary productivity [[Report](#)][[Slides](#)] [[Video](#)]
- 2.2.8. WG 157. Toward a new global view of marine zooplankton biodiversity based on DNA metabarcoding and reference DNA sequence databases (**MetaZooGene**) [[Report](#)][[Video](#)]
- 2.2.9. WG 158. Coordinated Global Research Assessment of Seagrass System (**C-GRASS**) [[Report](#)][[Slides](#)][[Video](#)]
- 2.2.10. WG 159. Roadmap for a Standardised Global Approach to Deep-Sea Biology for the Decade of Ocean Science for Sustainable Development (**DeepSeaDecade**) [[Report](#)][[Slides](#)]
- 2.2.11. WG 160. Analysing ocean turbulence observations to quantify mixing (**ATOMIX**) [[Report](#)][[Slides](#)][[Video](#)]
- 2.2.12. WG 161. Respiration in the Mesopelagic Ocean (**ReMO**): Reconciling ecological, biogeochemical and model estimates [[Report](#)][[Slides](#)]
- 2.2.13. WG 162. Developing an Observing Air-Sea Interactions Strategy (**OASIS**) [[Report](#)][[Video](#)]
- 2.2.14. WG 163. Coupling of ocean-ice-atmosphere processes: from sea-Ice biogeochemistry to aerosols and Clouds (**CIce2Clouds**) [[Report](#)][[Slides](#)]
- 2.2.15. WG 164. **CoNCENSUS**: Advancing standardisation of COastal and Nearshore demersal fish visual CENSUS techniques [[Report](#)][[Video](#)]
- 2.2.16. WG 165. Mixotrophy in the Oceans – Novel Experimental designs and Tools for a new trophic paradigm (**MixONET**) [[Report](#)][[Slides](#)]

2.2.17. WG 166. Developing resources for the study of Methylated Sulfur compound cycling PROCesses in the ocean (**DMS-PRO**) [[Report](#)][[Slides](#)]

2.2.18. WG 167. Reducing Uncertainty in Soluble aerosol Trace Element Deposition (**RUSTED**) [[Report](#)][[Slides](#)]

Appendix 5. Links to Research Project Reports

3.1. **GEOTRACES** – Marine Biogeochemical Cycles of Trace Elements and Isotopes [[Report](#)] [[Annex – Regional reports](#)][[Slides](#)]

3.2. **SOLAS** – Surface Ocean – Lower Atmosphere Study [[Report](#)][[Slides](#)]

3.3. **IMBeR** – Integrated Marine Biosphere Research [[Report](#)][[Slides](#)]

3.4. **IQOE** – International Quiet Ocean Experiment [[Report](#)] [[Slides](#)]

3.5. **IIOE-2** – International Indian Ocean Expedition 2 [[Report](#)] [[Slides](#)]

Appendix 6. Links to Infrastructural Project Reports

- 4.1. **SOOS** – Southern Ocean Observing System [[Report](#)][[Slides](#)]
- 4.2. **IOCCP** – International Ocean Carbon Coordination Project [[Report](#)][[Slides](#)]
- 4.3. **COBS** – Changing Ocean Biological Systems [[Report](#)][[Narrated Slides](#)]
- 4.4. **GlobalHAB** – Global Harmful Algal Blooms [[Report](#)][[Slides](#)]
- 4.5. **JCS** – Joint Committee on Seawater (IAPWS/SCOR/IAPSO) [[Report](#)][[Slides](#)]

Appendix 7. Links to Affiliated Project Reports

5.1. **IOCCG** – International Ocean Colour Co-ordinating Group [[Report](#)][[Slides](#)]

5.2. **InterRidge** – International RIDGE Studies [[Report](#)]

Appendix 8. Links to Affiliated Organization Reports

5.4. **IABO** – International Association for Biological Oceanography [[Report](#)]

5.5. **IAPSO** – International Association for the Physical Sciences of the Oceans [[Report](#)] [[Slides](#)]

5.6. **IAMAS** – International Association of Meteorology and Atmospheric Sciences
[[Report/Slides](#)][[Video](#)]

Appendix 9. Links to Partner Organization Reports

- 6.1. **IOC** – Intergovernmental Oceanographic Commission [[Report](#)]
- 6.2. **PICES** – North Pacific Marine Science Organization [[Video](#)]
- 6.3. **GESAMP WG 38**– The atmospheric input of chemicals to the oceans [[Report](#)][[Slides](#)]
- 6.4. **POGO** – Partnership for Observation of the Global Ocean [[Report](#)][[Slides](#)][[Video](#)]
- 6.5. **ISC** – International Science Council [[ISC Annual Report](#)][[Slides](#)]
- 6.6. **SCAR** – Scientific Committee on Antarctic Research [[Report](#)][[Slides](#)]
- 6.7. **Future Earth and the Ocean Knowledge Action Network** [[Report](#)][[Slides](#)]
- 6.8. **WCRP** – World Climate Research Programme / CLIVAR [[Report](#)][[Video](#)]

Appendix 10. Audited SCOR Statement of Activities

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH, INC.
STATEMENT OF ACTIVITIES
YEAR ENDED DECEMBER 31,
2022

	Without Donor Restrictions	With Donor Restrictions	Total
SUPPORT AND REVENUE			
Grant revenue	\$ 891,950	\$	\$ 891,950
Contribution revenue		7,321	7,321
Membership dues	405,059		405,059
Miscellaneous income	28,452		28,452
Interest income	97		97
NET ASSETS RELEASED FROM RESTRICTIONS			
Satisfaction of program restrictions	<u>35,738</u>	<u>(35,738)</u>	
Total support and revenue	<u>1,361,296</u>	<u>(28,417)</u>	<u>1,332,879</u>
EXPENSES			
Program services			
Scientific programs	896,894		896,894
Travel and subsistence programs	88,452		88,452
Other conferences and meetings	<u>7,754</u>		<u>7,754</u>
Total program services	993,100		993,100
Supporting services			
Management and general	<u>288,985</u>		<u>288,985</u>
Total expenses	<u>1,282,085</u>		<u>1,282,085</u>
CHANGE IN NET ASSETS	79,211	(28,417)	50,794
NET ASSETS			
BEGINNING OF YEAR	<u>349,013</u>	<u>74,140</u>	<u>423,153</u>
END OF YEAR	<u>\$ 428,224</u>	<u>\$ 45,723</u>	<u>\$ 473,947</u>