

IOCCG-27 Committee Meeting

Online, Zoom, 13 - 16 March 2023, 1 - 3 pm UTC daily

FINAL MINUTES

1.0 Welcome and Opening Session

1.1 Opening of the Meeting

The IOCCG Chair, Shubha Sathyendranath opened the virtual meeting, and thanked all participants of the meeting, especially those who were joining the meeting extremely early in the morning, or late at night. Shubha expressed the reduced carbon footprint of the virtual meeting, though she said it was not ideal going forward. A list of participants that attended the virtual meeting, and those that offered their apologies, is provided as an Annex to the minutes.

1.2 Adoption of Agenda, Review of IOCCG-25 Minutes, Status of Actions

The agenda was adopted after adding one new agenda item: an update on the Ocean Optics course in Maine by Emmanuel Boss during item 3.0. The minutes of the IOCCG-26 Committee meeting were approved. The following on-going or open actions from the IOCCG-26 meeting were reviewed as follows:

- *Action 26/1*: Open - First draft of the Report on Atmospheric Correction over optically complex waters is completed and a meeting to finalize the report will occur at the end of March 2023.
- *Action 26/7*: Closed - Ocean carbon task force will be addressed under agenda item 2.4
- *Action 26/8*: Closed - Report on MOBY investigations will be addressed under agenda item 4.3
- *Action 26/9*: Open - Cara Wilson to follow-up. No progress on this item
- *Action 26/10*: Closed - CEOS Analysis Ready Data will be discussed under agenda item 2.1
- *Action 26/12*: On-going - Proposal for the MOOC is on-going. Paula Bontempi is drafting a first pass document to help with this task.
- *Action 26/14*: Open - No update on this item
- *Action 26/15*: On-going - NOAA has provided in-kind support to IOCS-2023. Menghua Wang is still investigating other support.
- *Action 26/16*: Closed - New IOCCG proposal submitted to NASA
- *Action 26/17*: On-going - recommendations from previous IOCS meetings will be discussed under agenda Item 5.1

2.0 Discussion on CEOS OCR-VC, Working groups and Task Forces

2.1 Discussion on CEOS Ocean/Aquatic Analysis Ready Data

Ewa Kwiatkowska and Marie-Helen, Co-chairs for CEOS OCR-VC and representatives of the IOCCG agencies within CEOS, gave an overview of their role within CEOS and introduced a request that they received to contribute to CEOS Analysis Ready Data (ARD). The ARD oversight group was created in 2021, and Maycira Costa was nominated as the IOCCG representative to the group.

A CEOS ARD group for land reflectance defined product specifications for aquatic reflectance, and passed the document to the IOCCG for feedback and comment. It was initially suggested, too, that the OCR-VC should develop a separate ARD document for the ocean. It was decided, however, that since ocean colour is applicable to all water types (ocean, coastal and in-land waters) it was not suitable or practical to create a separate Ocean ARD product. The IOCCG therefore needs to contribute to, and revise, the existing aquatic definitions for the ARD, to ensure it is all-encompassing. The Product Family Specification document for Aquatic Reflectance ARD is structured as requirements for general metadata and per pixel metadata, as well as radiometric, atmospheric, and geometric corrections. Our current contribution would be on the definition, which includes threshold and target requirements.

Ewa indicated that we would ideally select a group within the IOCCG to review the existing reflectance document and ensure it represents the IOCCG view. She mentioned that the IN-SITU OCR White Paper contains a lot of recommendations which are applicable to the ARD document and should be referenced. Links to existing documents in CEOS need to be made. She also indicated that the current document lacks requirements for data formats (e.g. netcdf file format with CF compliant metadata), which could be added, and also pitched the suggestion for the ARD recommendations to include cloud applications, and other data accessibility and data visualization tools. Use of metrological standards and naming strategies (e.g. “accuracy” changed to “uncertainty”) also needs to be examined. She requested that a few people contribute to the revision of the document. If such a document needs to exist, then it is best to have a knowledgeable, comprehensive contribution from IOCCG.

In response to a question from Jeremy Werdell about whether this task would move forward by CEOS with or without IOCCG, Maycira explained that the initiative originally came from the land ARD specifications, which included an aquatic specification for ratification. Maycira indicated that she believed the IOCCG should be included in any aquatic specifications. The matter was raised at the last IOCCG Committee meeting, but feedback was still pending. The CEOS ARD working group would love to have their specification documents move forward, so feedback from the IOCCG should be timely. Claudia Giardino also indicated that the original discussion of the Aquatic Reflectance group was specifically targeted to inland and coastal waters, and was derived from the CEOS land surface ARD with certain modifications and additions by GEOAquaWatch, WaterForCE, and other subject matter experts. This does not exclude oceans but reflects that the original document was not specifically designed for oceans. She indicated that it will be very important to revise it for oceans.

Jeremy volunteered to assist with the review. Claudia also volunteered.

Shubha recapped that IOCCG agreed that it would be best to have a unified document. She indicated that the agencies should start looking at it and making comments, and recapped that the INSITU white paper is very relevant and should be cited. Maycira said the best approach would be working together with the Aquatic reflectance group on a path forward, so a conversation with them is key to moving forward in a manner beneficial to the user community.

It was agreed that a review by the end of the year would be good, so that a final review can be done at the IOCS meeting before hand over.

Action 27/1: *Ewa Kwiatkowska to organize with Maycira Costa a meeting with Arnold Dekker and/or others leading the Aquatic ARD effort to confirm the way forward, indicating that IOCCG wishes to contribute towards this document.*

2.2 Discussion on CEOS Aquatic Carbon Roadmap

Marie-Helene explained the CEOS Aquatic Carbon Roadmap that has been added as a deliverable for the OCR-VC on the CEOS work plan for the next 3 years. Marie-Helen showed the context and reasoning of the roadmap in relation to the Global Stocktake. She explained that there has been a lot of effort done by the OCR-VC over the last 6 years to first develop a white paper, which led to a roadmap on greenhouse gas (GHG), and then to an initiative to develop a roadmap for agriculture, forestry, and other land uses (AFOLU), which has a target of submission for July 2023.. In the context of the GHG roadmap and AFOLU roadmap, the aquatic community is ready to contribute with an aquatic carbon roadmap as the 3rd leg of the CEOS carbon strategy. Aquatic carbon is fundamental in this context so there is a strong need for the roadmap to help improve visibility on our activities and the ability of ocean colour to inform aquatic carbon.

She highlighted that there have been a few activities in the last year

- Ocean carbon from space workshop
- Community white paper – which represents the first draft for the roadmap
- Carbon special issue
- Earth Science reviews special issue

The roadmap should cover the next 3 years, with a deliverable due at the end of 2025. It would require a lot of work and Marie-Helene suggested that we should start by preparing an outline and assigning the tasks for the contribution of everyone interested in the outline and the roadmap. Example objectives (taken from the AFOLU roadmap) could be:

- Provide framework for long term coordination
- Serve as guiding vision for long-term space agency
- Characterize needs
- Provide effective means for communicating to society and
- Addressing basic observation continuity

The group is free to modify and give specific objectives.

Marie-Helene indicated that she has been invited to the CEOS Strategic Implementation Team (SIT) meeting and will have 15 mins to present plans and needs to accomplish this task. She has been advised to take advantage of this slot to make a case for the roadmap and benefits to CEOS and the agencies, indicating what is needed by way of resources, issues, and challenges to fulfill this goal. The Committee agreed to give Marie-Helene feedback on information to go into slides for her presentation at the CEOS SIT meeting. The slides are due next week.

David Antoine asked whether productivity was out of scope. Shubha indicated that she believed that we need to consider the carbon and processes in the ocean, which can become an all-consuming task that we would need to plan and manage effectively. Marie-Helene indicated that it was for us to define the content and scope of the roadmap. She indicated that there is also a formal link with the IPCC and global stocktake that could be considered. Shubha indicated that it requires a lot of careful planning.

Ewa Kwiatkowska indicated that we can acknowledge within the roadmap areas that still require quantification, those that need to be developed, as well as where gaps lie. This would be very useful on its own so that as the agencies take the roadmap they could try to coordinate and fill these gaps. Shubha agreed, and indicated that we can say that our plan will include taking stock of what is happening inside the ocean, the budget, and whether it is changing globally and regionally.

Marie-Hélène agreed. As the aquatic carbon roadmap does not have the same degree of maturity as the other two roadmaps, she suggested we may want to focus on different things. It is up to us to define and express our limitations. We can state where we are not at the point that we can provide a contribution to the stocktake and what we would need to get there. Shubha indicated that we should also develop timelines according to the severity of the gaps. Marie-Helene requested that we unite to decide what we can provide in 2-3 years. Shubha agreed and volunteered to contribute. She also suggested we could start with some of the points from the Task Force on ocean carbon. Hubert Loisel and Laura Lorenzoni volunteered to assist. Claudia Giardino volunteered to help with lakes.

Marie-Hélène agreed to distribute draft slides to the Committee for comments before the final meeting session on Thursday. The discussion was continued under agenda item 7.2.

2.3 Lead and goals of the Hyperspectral Task Force

Astrid Bracher and Jeremy Kravitz have agreed to lead the Hyperspectral Task Force (TF). They were requested to address two main overarching goals for the Hyperspectral TF:

- the key quantitative advantages of hyperspectral over multispectral ocean colour radiometry (including across study ranges, water types, and varied sensor specifications)
- the science that hyperspectral OC radiometry addresses that is not being addressed by current and planned missions

Astrid gave an overview of some very preliminary thoughts on what they might be addressing, but Jeremy, who was away on leave, still needed to be consulted and to ratify the ideas, as well as the proposed members. Astrid indicated there would be a virtual meeting of the TF, and then maybe an in-person meeting at or in conjunction with the next IOCS meeting in November. She said it would be good to have a workshop in 2024, where they would invite people to show activities linked to new satellite missions.

Regarding the question of what hyperspectral will do better than multispectral, it was thought that the TF could select 2- 3 very specific questions within this theme and address them, rather than enter into more generic work. Astrid agreed. As hyperspectral missions and studies are already in progress, it would be good to focus efforts around these, and capitalize on existing work.

2.4 Ocean Carbon from Space Task Force

Cecile Rousseaux presented on behalf of Jamie Shutler who could not attend the meeting due to a teaching commitment. Cecile gave the background for the TF on ocean carbon. She indicated that quantification of ocean carbon requires satellite data (including ocean colour, but also sea state, etc.), and Jamie presented at the last IOCCG meeting that many ocean estimates rely on satellite observations. However, the limitations of the satellite data are not clearly understood or the data are not used to their maximum efficiency to contribute to global carbon assessments, and so there is a clear need for satellite data expertise involved in these large-scale global carbon efforts. Though the quantity of satellite data will increase over time, we are still struggling with basic questions (e.g. is the Southern Ocean a sink or source? What role does changes in biology play? How will the ocean sink change in future?). The wider ocean carbon budget is overlooking some of the Earth observation (EO) satellite advances to estimate the role of the ocean in the carbon cycle. There have been publications that try to estimate the role of satellite data in ocean carbon, but clearly a cross-disciplinary group is needed that can give coherent advice and guidance, and the IOCCG could provide this leadership in conjunction with other groups for carbon (GHRSSST and sea state, etc).

The Ocean Carbon TF would

- Encourage uptake of climate quality satellite data records
- Provide support to annual assessments and related workshops (e.g. IPCC)
- Support the aims of the CEOS carbon strategy

Jamie has submitted a paper to *Aquatic carbon stocks and fluxes: The big picture from remote sensing within Earth Science Reviews* which explains the need for aligning scientific communities.

Jim Yoder asked whether satellite lidar measurements of backscatter to calculate ocean particulate carbon was included as an ocean colour contribution? Shubha thought yes.

Shubha reiterated that the priority has been determining a budget for the atmosphere, but as the ocean community, we should go beyond the atmospheric budget to understand what is happening in the ocean. Cecile said the Earth System model community is starting to think about the carbon within the ocean, and how the ocean is changing in response to atmospheric CO₂ and the interplay between the two. Marie-Helene expressed that it is very correlated anyway, so that it is not possible to look at the atmosphere without looking at what is happening in the ocean. Shubha indicated that while this was so, our reporting should explicitly include what is happening in the ocean. Emmanuel Boss indicated that ocean biology is playing a very small role in the atmosphere because mostly it is a physical-chemical pump with seasonal modulation by biology in the ocean. He said focussing on the change in biology in the ocean *in the future* is very important, especially when the pumping stops. So the effect on biology is critical and will definitely have an impact. Cecile indicated that the TF can raise awareness of the role of the ocean in the long-term assessment.

Hubert Loisel indicated the export of carbon should also not be forgotten, as is fundamental to understanding the effects on the atmosphere. There are a lot of projects funded by agencies on this topic. He suggested that agencies (within the EU, but outside as well) should discuss what has been done and what is already funded, so that we can have collaborative projects and reduce redundancies. IOCCG could be a good place to list all the projects, for better uptake and interaction.

Robert Frouin indicated that he thought the TF was a good opportunity to recognize the importance of CO₂ at the scale of countries, because emission budgets of each country does not consider the ocean, but each country has an EEZ and the changes in those areas should be included. Shubha expressed that we should resist the temptation to partition the ocean on economic grounds.

Action 27/2: *IOCCG Project Office to communicate to the Ocean Carbon TF leads that the scope should include processes within the ocean.*

2.5 Proposal for New Working Group: Ocean primary production from space

Bob Brewin presented the background of the idea for an IOCCG working group (WG) on ocean primary production from space. This arose from a session on Primary Production Estimation led by the proposed chairs at *The 6th Xiamen Symposium on Marine Environmental Sciences (XMAS)* held in January. He gave an introduction to the carbon cycle, indicating the importance of primary production in the role of increasing ocean carbon storage. Production is also key for fisheries which sustain the ecosystem, and that energy is dissipated as it moves through the food web. In the mid 1990s, ocean carbon production was quantified and

the large role that the ocean plays in global primary production was emphasized—this was a large achievement of ocean colour. Although there has not been an IOCCG report on the topic, an enormous amount of work has been conducted internationally. Despite this work, there are still fairly large challenges. Notably, there are large uncertainties in modeling primary production from space, and this was highlighted in a recent IOCCG report. Oceans are warming, and increased stratification is modifying nutrient contents, which affects primary production.

Bob stated many opportunities to improve model primary production, including:

- application of the IOCCG Protocols for measuring aquatic primary production
- new in situ observations that can help map vertical structure in primary production input variables and parameters
- a suite of satellites launched or planned for launch with higher spectral resolution so we can look better at physiology
- geostationary platforms that use direct observations.
- work in IOCCG Report 18 that could be useful for propagating to primary production estimates.

He gave an overview of the initial plan for the WG, which, among other things, included to:

- summarize the advantages and limitations of the various primary production algorithms and identify pathways for improving estimates from satellites.
- compile a match-up database of concurrent and co-located in-situ primary production data and satellite ocean-colour measurements.
- obtain ensemble estimates of global primary production of the past two decades with the latest algorithms and satellite products.
- provide a thorough account on the sources and magnitude of uncertainties in satellite estimates.
- discuss potential of new technologies for improving estimates, and provide recommendations and action for improving primary production remote sensing.
- discuss the socio-economic costs associated with inaccuracies of primary production estimates.

Emmanuel Boss asked whether there were enough in situ estimates to adequately evaluate primary production algorithms.

Chuanmin Hu thought it was timely to potentially resolve the disparity among different primary production models. Bob indicated that he hopes the IOCCG Report on primary production would be a key resource for modelling primary production and would leverage the work on a scientific roadmap for quantifying primary production and reducing uncertainties. Chuanmin agreed that even understanding uncertainties in each model is very important.

David Antoine agreed on the importance of the group. He indicated that the timeline of 3 years to complete the activities seemed ambitious. He raised that in the 1990s to early 2000s, Fast Repetition Rate Fluorescence was introduced as the state of the art, but the problem was the conversion of electron transport to carbon quantities. He suggested the WG could help to

address this problem, and give better guidance of the most appropriate in situ methods/ review of existing methods and how to effectively use instruments for carbon productivity.

Cara Wilson agreed that the proposal was timely, as NOAA has been trying to determine which algorithms to use for primary production estimates, especially with application to fisheries.

Marie-Helene expressed support for the WG and thanked Bob for the presentation. She asked about trends in primary production. Due to the uncertainty on different products, it may be hard to calculate robust trends, but it is an important aspect to be examined. This is especially important for collaborative projects (e.g. across ESA/NASA/JAXA) as there is a lot of data to investigate within these projects, but the differences pose difficulties with respect to determining trends. She suggested trends in primary productivity be carefully considered as part of the WG activity.

Hubert Loisel indicated that temporal variation in inherent optical properties (IOPs) can be obtained from geostationary ocean-colour data, and this could be considered when integrating satellite data into primary production algorithms.

Robert Frouin asks whether this activity could include a numerical modeling component (i.e. estimate primary production from models using satellite data). Bob indicated that numerical modelling was too broad a topic, and the WG preferred to stick to satellite observations to constrain the scope of the report.

Shubha indicated her support for the WG, and said she frequently has discussions in which the user community indicate that they do not know which primary production algorithms and products to use, or the differences between them. She suggested that it would be good to consider how to improve confidence in the numbers produced by remote sensing for the climate community. A community effort that examines the similarities, differences, and uncertainties would be good for the climate debate.

Shubha indicated that for things to be cited readily in an IPCC report, they often refer to peer-reviewed publications. She indicated that it may be worthwhile to publish some key findings in a peer-reviewed journal so that the reach becomes more broad. Bob indicated there was success in the Ocean State report where they publish the report, and then publish parts of the report in other journals, for reach.

A discussion was raised on whether IOCCG reports have the status of a peer-reviewed publication. The comments indicated that the review process of the IOCCG Reports were not clear. The Reports are considered peer-reviewed, and are citable with their own DOI. The 60-day open review process for the Protocol Series was more clear, but the review process for the Report Series was less so. Hubert suggested advertising the way in which the reports are reviewed (i.e. the full process) on the IOCCG website, because some people may believe they are internal reports, reviewed only by internal IOCCG members. There was agreement that IOCCG needs to communicate more broadly how the reports are peer-reviewed.

Action 27.3: IOCCG Project Office to advertise the review process for IOCCG Reports to encourage uptake as a peer-review document.

2.6 Proposal for New Working Group: Classification of optical water types

Thomas Jackson gave a brief overview of this proposed WG on Classification of Optical Water Types (OWT). The OWT approach gives a similarity metric for assigning different optical water types. He indicated that similarity metrics are useful for water types because no single algorithm works across all water types. Algorithms can, however, be blended across transitions from open ocean to coastal to in-land. By identifying which OWT we have already sampled extensively, we can focus future in situ measurement campaigns on areas where we have least observations.

Tom indicated that there are a range of factors that go into the creation of an optical water type cluster set, and within one cluster scheme, there are many parameters that lead to complications. The range of approaches used across the community and the lack of harmonization are the main gaps that the proposed WG aims to address. The WG objective would therefore be to consolidate techniques to reduce duplication of effort, and increase the ability for schemes to be directly compared. He stressed that there was no focus on creating a perfect water type set, but rather of having methods that are common.

The WG plans to present all the data on OWTs in a clear manner so the method gets standardized and implemented more widely, with a commonality of approach and assessment. This is important to set the stage for future applications, for example, implementation of classification schemes using hyperspectral data.

The WG report structure was proposed. Though some chapters were quite technical, the WG plans to have ocean colour examples throughout the report. They will use cluster sets in the ocean colour context to demonstrate more complicated concepts. Proposed membership and timeline for report were discussed, with proposed completion by the end of 2024.

Vittorio Brando indicated that there is a need for an OWT approach. He thought the timeline of the end of 2024 is a bit too aggressive, and should be acknowledged. Regarding group composition there were a few additional suggestions.

Chuanmin Hu suggested an additional objective: to provide a consumer guide to users so there is less complexity and confusion, as users often default to the two water types within the case I and case II water classification. Tom agreed. Tim indicated that over the last 20+ years there has been a growing use of OWTs so examining these from the present-day perspective and consolidating the method is good, but application towards ocean colour data is the PRIME objective. Use of the method is widespread enough that we need to consolidate approaches, but also to clarify the water types and how to use them.

Hubert thought the proposal was very timely. Many people are using classification schemes for algorithm development purposes but it would be good to see how they can be used for application. He asked whether the WG has a plan to have a section on the link between optical classes, IOPs, and biogeochemical components. Tom indicated that groups have tried to characterize OWT by assessing the range in CHL, B_{bp} etc., but this requires additional

datasets. This could fit well into chapters 3 and 4, and they could highlight where these water types are useful, and define their properties.

The WG was asked whether they plan to address spectral resolution: if spectral resolution is increased, does this improve the OWT approach? And what about low spectral resolution, as for in-land waters. Tim and Tom indicated that they thought about increased spectral resolution and hyperspectral sensors, and would involve hyperspectral missions, (e.g. PACE), as well as liaise with those working with low resolution spectral bands (e.g. MSI). Tim indicated that having IOPs define the water types is fundamental to the classification system.

Ewa agreed with the inclusion of in-land waters and the bio-optical interpretation of these water classes. She thought it was critical to the understanding and application of the various classification methods. She asked whether the WG would start from satellite data or from in situ data. Tom indicated that both approaches are currently used by the community, and that clarification of these methods would be part of the report. Ewa indicated that uncertainties should be included. Tom agreed, indicating that there would be a section of the report dedicated to what can and cannot be seen in clusters.

Jeremy Werdell asked whether the objective to use classification schemes with combined in-situ and remote sensing data could be expanded to address recommendations or gaps related to consideration of external information (SST, MLD, other hydrography, etc.).

Shubha asked about the integration of water types with Secchi disk depths, as this has been used extensively. Shungu agreed, adding that there is benefit in including Secchi disk and Forel-Ule datasets, considering the amount of open-access observations that exist across various water types.

Action 27/4: IOCCG Project Office to communicate to WG chairs that their proposals have been approved and to pass on the comments from the meeting (including the chat).

2.7 Existing Working Groups & Task Forces

Reports on the progress of existing WGs and TFs were submitted by the respective chairs, and made available on the IOCCG website.

Shubha noted that the example chapter from the WG on Conducting Benthic Reflectance Measurements (*Chapter 2: Physics of Bottom Reflectance, Fournier*) seemed to be an excellent start to the report. If the rest of the report is in this shape, it will be a good report.

Shungu indicated that the WG on Marine Litter & Debris is planning a workshop to provide an update on the activities from ESA have achieved and hopefully find a link as an assessment. Shungu indicated that collecting material for a report has been a problem. Members are opting to publish individual papers, and are heavily contributing to various activities. He requested whether these contributions can be considered deliverables of the TF. He indicated that it is not possible to provide a timeline for publications in peer-reviewed journals, but that the TF would ensure data is made open access and compile a list of resources.

Ewa indicated that the TF on satellite calibration is for the involvement of instrument calibration experts. The TF is planning to meet at the next IOCS meeting and submitted a proposal for a breakout workshop to engage with the community. The TF met a year ago online, and have no specific updates yet. The in-person IOCS meeting is for exchange of knowledge and experiences.

Ewa also indicated that for the TF on System Vicarious Calibration, she contacted the nominees for potential members and has had 3 positive responses thus far. The full remaining membership is available in the report she submitted on the website, and includes people from many different agencies, including those involved in the preceding WG on System Vicarious Calibration. The TF chairs have a meeting on 4 April 2023.

Shubha asked whether the growing portfolio of IOCCG was still manageable for Ewa, as chair for 2 TFs and also a representative of IOCCG for CEOS. Ewa indicated that she needs to have discussions about passing on some of the responsibilities.

Action 27/5: Ewa Kwiatkowska to have discussions about passing on responsibilities, perhaps of one of the task force leads

3.0 Capacity Development

3.1 Update on Summer Lecture Series (SLS-2024)

David Antoine presented a quick update on the IOCCG Summer Lecture Series (SLS). He had proposed the SLS to the IOCCG in 2010 as Chair at the time, and it was endorsed and organized every other year since 2012 (except for 2020). David has coordinated the SLS since then, and it is systematically hosted by Laboratoire d'Océanographie de Villefranche (LOV). IOCCG receives a large number of applications (~140) for each round. Students are fully supported, and come from all around the world. A total of 10-12 lecturers are also fully supported for travel and accommodations. This has included ~30 different people contributing to lecturing over the years. Sessions are a mix of lecture and practicals and lectures are audio and video recorded with good statistics on downloads and watches. The full budget is about USD 80,000 and IOCCG covers about 25% each year. Other funders include CNES, EUMETSAT, OCB, SCOR, etc.

A total of 117 students have directly benefited from the SLS to date. As David is no longer at LOV, the time he spends planning the SLS has become hard to justify to his new institution, so a new coordinator and venue need to emerge. After 10 years of the SLS, now is a good time for a hand-over to someone new..

The group considered and discussed many suggestions, including an existing proposal from the Indian National Centre for Ocean Information Services (INCOIS), and suggestions to have a regional series that rotates locations, with lectures tailored for the region. It was decided not to move the SLS around each time, due to logistics and expense, but to find a new home. It was also decided to leave the SLS in the summer (northern hemisphere), as this was the best time for lecturers to volunteer their time.

Though one proposal was already in-hand, it was decided that an open call for expressions of interest should be put out to engage a wider community. In this call, we will make clear that the logic and content for the SLS would be at the discretion of the IOCCG. Cara suggested that the current IOCCG mailing list is a good place to screen for interest, and that we might not get more requests than we can screen. She offered to help screen if IOCCG received too many submissions.

Action 27/6: IOCCG Project Office in conjunction with David Antoine to draft wording for call for proposals to the community for potentially hosting the summer lecture series from 2024 onwards.

3.2 New Proposal for Training: Advancing the application of ocean color remote sensing in Africa through the Early Career Ocean Professionals (ECOP) Program

During the call for new working groups, a proposal for a working group on training was submitted by the Early Career Ocean Professionals (ECOP) Program Africa node. The proposal was passed to the Training & Education (T&E) subcommittee for review and discussion. Raisha Lovindeer recapped the proposal's aims and the comments from the T&E subCommittee, which acknowledged the merit of the proposal, and raised questions around funding, the training approach and output, and the training personnel.

Arising from feedback from the T&E subcommittee were questions around the focus of IOCCG training, and whether on fundamentals of ocean colour science, or on data use and application. Shubha indicated that it was important to provide training tailored to the needs of the potential trainees, and this spoke to a point raised earlier by Emmanuel Boss about the importance of being inclusive in training. To give context, Raisha indicated that other trainings exist on the application of specific data, usually offered by the data providers, so the question was about what IOCCG can offer that is different from what already exists. Shubha agreed, but also indicated that there seems to be a need for this type of application oriented training. Cara Wilson agreed with the point about the need for application-based training, and its ability to expand beyond ocean colour.

Shungu Garaba indicated that there are currently needs regarding the African Great Lakes and the application and expansion of simple and useful approaches, like Secchi disks etc. He thought the proposal was very interesting and could be complemented by some of the work already being done on African Great Lakes by a consortium of institutions in Africa (<https://www.agl-acare.org/rit-project-2022>).

3.3 Results of the 2023 Trevor Platt Scholarship Selection

Applications opened for the first time in 2022 for the Trevor Platt Scholarship, with two awards issued for the inaugural year. The award targets students and early career scientists from developing countries and emerging economies to spend time at host institutions in a

foreign country for ocean colour training or research. 10 applications were received for the 2023 award. Applicants provided details of their proposed research project or training program, along with copies of their CV and letters of recommendation from the home supervisor as well as the host institution.

A small review committee was established to make the selection for the award, and the two awardees for 2023 were Arjun Adhikari (India) to work with Heidi Dierssen (USA) on the application of ocean color data to understanding the impact of discharge from shrimp farms in the coastal ecosystems of the Gulf of California; and David Alejandro Gonzalez Rivas (Mexico) to work with Hans Burchard (Germany) on a numerical study for deriving coastal colour components and physical processes from satellite data.

It was asked whether there would be follow-up on the research activities of the Platt Scholars after they were completed. Raisha indicated that the scholars have been invited (with travel awards) to present their funded research at the IOCS meeting in November.

3.4 Ocean Optics Class in Maine

Emmanuel Boss shared the details of the next US-based Ocean Optics class (Workshop on Calibration and Validation of Ocean Color Remote Sensing), scheduled to occur from 12 June – 7 July 2023 at Bowdoin College, Schiller Coastal Studies Center (SCSC), Orr’s Island, Maine.

The class started 1985 at the Friday Harbor Laboratories and moved to the Darling Marine Center. The last two have been held at the Boden Marine Station. Travel within the US is provided by travel awards from OCB, and international students (in the past) have been supported by POGO. Most of the students are graduate students with a few being postdocs and professionals. Approximately one third of the students are from other countries. The course is 4 weeks long. All 7 lecturers stay for the full duration of the 4 weeks to facilitate discussions and learning. Emmanuel plugged that the last day for applications for the 2023 course was 15 March 2023 (the next day).

Emmanuel indicated that he was retiring from running the course, and Meg Estapa will coordinate the next course, in 2 years. (The course is held biennially, alternating with the IOCCG Summer Lecture Series).

4.0 Other Ocean Colour Related Business

4.1 Update on Nomenclature activity

Robert Frouin gave an update on the current nomenclature activity happening within GEO AquaWatch. The group functions similarly to an IOCCG working group, in that the members are self assigned to areas and work voluntarily. Lists of entries are being established and some formats have been proposed. A website for the activity has been created with much of the information of the WG. Currently, people work through a shared Google folder that shares all the documents, graphical resources, and references. Additional papers have also been

proposed but the reception has been lukewarm as these may detract from the main purpose of the group. Robert believes the effort is a good one. Activities should close in 2024 which might be an aggressive timeline.

Robert asked about the role of IOCCG, as just an endorsement of the work, or will we require a review, and to make recommendations? Robert's concern was that the terms we commonly use might appear as footnotes of major definitions. Emmanuel Boss and others indicated that there is a huge amount of overlap with IOCCG and the group regarding the people involved. As the group is open, and composed of existing IOCCG members, the IOCCG does not have a different agenda. It was suggested that if a topic of interest emerges where there is no direct involvement of IOCCG members, or assistance is required, then maybe more members can be invited to give their opinion. Shubha indicated that it is good to have common terminology appear as an entry and cross referenced, so that it does not get lost in a footnote. Cara reminded Robert that he and others currently act as IOCCG representatives to the group [from Minutes of the IOCCG-26 meeting: "Several members from IOCCG volunteered to join the effort including Heidi Dierssen, Robert Frouin, Vittorio Brando, Claudia Giardino, and Frederic Melin, as representatives of IOCCG, and the consensus was that a descriptive over prescriptive approach is preferred"].

Claudia Giardino agreed that there are some areas that need to align between the communities. For example, normalized water leaving radiance of ocean colour is one of the key points we will try to align between the two communities.

4.2 Request for IOCCG to help with consistency across missions regarding satellite Rrs and [Chl] data

Emmanuel Boss indicated that there are many more ocean colour missions than ever before. He indicated that this was good, as it is much better to have more sensors than less—they will not all agree, but there is much to learn from the disagreement. It allows us to build gapless products (L2, not L3) with shorter repeat time and much less cloud effect by merging the different missions. But merging is not trivial as data from the different missions are different, and the difference is larger than one would expect based on published literature, especially atmospheric reflectance. Within the meeting participants, close to half indicated that they get significant differences (> 5%) for CHL, and it is not clear what contributes to these differences. With no clear guidance, users do not know how to account for differences to maintain consistency across products. There seems to be a need to evaluate existing differences. If uncertainties within missions are consistent but the differences across missions are larger, it seems there are unknown unknowns about uncertainty. He raised that it is important that newcomers who want to use L2 data are made aware of these differences.

Emmanuel suggested that a primer for each mission should exist. This primer could give detailed information on vicarious calibration (e.g. with MOBY? Lunar?), differences between uncertainties before/after reprocessing, etc. He suggested that the IOCCG is a natural place to

provide this guidance in a standardized way. IOCCG could think about what steps need to be taken to help the community understand better how to deal with these differences.

David Antoine showed an example of a collaboration within Australia where they attempted to address this problem. The aim was to provide global full coverage of CHL to study the marine ecosystem/carbon cycle, elemental change and drive 3D coupled models etc. They used multi-sensor processing to improve spatial coverage to see more of the ocean. This approach is future proof, as it does not rely on only using one source of sensors, but multiple sources. They aimed to include uncertainties at the pixel level to improve confidence in the product, and have full flexibility to do product testing. They also aimed to build capability in Australia.

David showed the algorithms used, and highlighted the propagation of instrument uncertainties. He showed examples of results from different sensors (S3A-OLCI, Aqua-MODIS, SNPP-VIIRS, and all of them together), at different time periods (single day, 8 day, monthly). There was rapid improvement in the coverage over using single sensors. David also showed the product consistency of Chl-a, and the consistencies were the same for all time scales, showing uniformity. Propagation of instrument uncertainty can be combined with products to derive relative uncertainty in %. This gives an idea of whether the product fits with requirements and can help determine which to keep in the analysis.

David shared the following link <http://mrs-data.csiro.au/imos/ntp-ocr/> and indicated that the members are free to use the product and give him feedback as it is in the user engagement period for which feedback is welcome. Improvements will include more processing.

The floor was open for general discussion.

Hubert indicated that the problem is not new. If we are looking for optical signals we can see large differences. With the plethora of papers from 10 different missions, it is not clear to users which to use. It was the task of the Climate Change Initiative (CCI) to try to solve this problem. Hubert indicated he is interested in David using the CCI product for reflectance and [CHL]. He also mentioned GlobColour, which takes all products from different satellites, but then there is uncertainty to merge. It is interesting to see how these are comparable. David indicated that he conducted comparisons with the GlobColour product and there is a report on the validation that will be available on the website soon. Some parameters compared well (e.g. reflectance at 490 nm), but others did not.

Hubert indicated that Landsat 8 and Sentinel 2 do intercalibration at the top of the atmosphere (TOA). This is a very important step, needed to reduce bias. It is easy to do with Landsat 8 and Sentinel 2 because of the restricted region. He asked David if he readjusts the TOA signal for the sensor he is using. David indicated no, they did not adopt vicarious calibration at the moment. They trust individual missions to have done their absolute radiometric calibration properly and try not to include differences.

Frédéric Mélin indicated that it is clear that these issues are important and have been known for quite some time. He indicated that we need analyses like this on larger scales. From work on comparing data from 2 VIIRS sensors, differences vary by wavelength, season, water type,

etc., and it is difficult to separate the effects of aerosol geometry. It is also hard to delineate all differences in sources and create synergy between products. In CCI, differences in seasonal and space variation led to very large bias correction that varied in space and climatology – it is possible to eliminate the main source of intersensory biases but not explain it. Shubha indicated that this is a problem that CCI has had, especially in the context of creating long time series for climate change studies. Elimination of intersensory bias is empirical with no explanation of underlying processes, though they examined whether bias can be explained as potential sources of error.

Emmanuel indicated that he would like the IOCCG to explore (from the user’s perspective) whether a document could be derived to help users understand this issue. It could inform references, approaches they can implement, basic information about missions, how each mission does its calibration, drift adjustment, etc., so users have a sense of whether there are differences, and what is the best practice recommendation. Document all things that users need to know if they are working with multiple sensors.

Chuanmin Hu agreed, indicating that there has been a lot of talk about uncertainties, including at the most recent PACE team meeting. Every time a comparison is made, there are always differences. So from a user perspective, the differences need to be documented and it should be noted whether these differences would impact trend analysis. Meanwhile, developers can examine how to resolve these differences. He noted that there are also different types of users, but most do not care WHY differences exist, they only wish to know if differences impact their conclusion. He suggested specifying change detection differences in % would be very helpful. Shubha indicated that this is what CCI would want and this is an area where community effort would be good. Claudia agreed, indicating the same problems exist in lake CCI.

David agreed that most end-users simply want an uncertainty measurement. He acknowledged that it is a difficult problem, but said it would be best to have a certain level of uncertainty documented with the product. Shubha asked if this could be discussed at the agency level, for example, as part of the CEOS carbon roadmap. She indicated that if the roadmap will look at long-term changes, it would be worthwhile to address this problem in detail.

Amir Ibrahim indicated that they are producing pixel level uncertainty for several ocean colour missions, and agreed that simply having confidence in uncertainty might not be sufficient because of the bias in missions. The validation would need to be captured.

4.3 Outcomes of investigations on causes of seasonal bias observed in vicarious calibration measurements from MOBY and the implications

Amir Ibrahim gave an update on NASA’s investigations into the causes of seasonal bias observed in vicarious calibration measurements from MOBY. He indicated that the root of the seasonal bias problem could be coming from different sources in the processing chain: calibration, BRDF or temporal trends, issues in MOBY in situ data, atmospheric correction, etc. He gave an overview of the background of the issue, which stemmed from comparative

analysis by [Bisson et al., \(2021\)](#). He showed that $B_{bp}(531)$ from MODIS aqua had seasonal variability that did not exist in CALIOP and Argo. Ratios show a constant bias, but also a seasonal bias between the two observations: MODIS b_{bp} to CALIOP b_{bp} have latitudinal discrepancies. Overall, there is a constant bias in green between satellite and MOBY data.

Regarding IOPS, backscatter was most affected relative to plankton or CDOM absorption. It was difficult to figure out what was causing the bias, and the issue is still evolving. Amir showed comparisons of standard processing Rrs 2018 versus 2022 for SeaWIFS, SNPP, MODIS Aqua and MODIS Terra. MODIS Aqua showed the largest bias in all bands compared to other sensors and was very consistent with Bisson et al., (2021). MOBY data is treated as a multispectral sensor. The nearest band is selected and there are always slightly shifted matchups with MOBY compared to satellite data. For example, 547 nm to 550 nm—2 or 3 nm shift—creates 10% or so constant bias in the data and makes the seasonal bias even worse than if no constant bias existed.

Amir concluded that additional insights are needed, and that NASA's Ocean Biology Processing Group (OBPG) is actively working on a resolution. Constant bias is introduced in validation at MOBY. There is a likely instrument-dependent issue with calibration and there could be residual atmospheric correction biases, though he felt the latter was not likely the leading cause to the seasonal bias in MODIS Aqua. Menghua Wang raised that when doing vicarious calibration, MODIS data is weighted with other data, so he did not understand the band shift. Amir replied that after validation, the full spectral response is not applied to validate the satellite data, only the closest band for the validation is selected, and this causes the constant bias.

Hiroshi Murakami presented data from GCOM-C/SGLI vicarious calibration tests using MOBY and Aeronet-OC, where seasonal biases were also found. The seasonal bias shows the opposite phase in the southern hemisphere, and is higher at higher scattering angles at every site.

Chuanmin reiterated seasonality in the bias having an opposite sign between the two hemispheres. From his team's work, he indicated that the bias could be due to the long-near infrared gain sensitivity to geometry.

Ewa indicated, from EUMETSAT's experience when conducting vicarious calibration for OLCI, and understanding MOBY data and products, that proper implementation of the BRDF correction was very important, as well as understanding how to match with typical satellite processing and in situ data. She indicated that significant bias could stem from how BRDF is estimated, and consequently Rrs. Thus, there are many points to investigate. EUMETSAT will also be addressing this issue.

Shubha indicated that it was good that the space agencies were working on the issue, and that it would be beneficial for them to collaborate, and to keep each other informed. She indicated that the issue should be discussed again at the next meeting opportunity. It was

decided that a group should be formed from those working on the topic from the various agencies and institutions, to share learnings and discuss.

Action 27/7: IOCCG Project Office to reach out in a joint email to those working on the topic of seasonal bias and give them the opportunity to form an informal group to share ideas and findings.

5.0 2023 International Ocean Colour Science Meeting (IOCS-2023)

5.1 Previous IOCS breakout workshop recommendations

Cara Wilson gave an overview of one of the goals of the IOCS: to come up with recommendations to the space agencies and the IOCCG. Within 4 IOCS meetings, there have been 34 breakout groups and 75 session chairs. Cara divided the groups into 20 themes and went through all the reports and pulled out 159 recommendations. What has happened to them all? She indicated that it is time to have a thorough review of the recommendations.

She showed the classification of the recommendations by executor (entity/person who should action it), as well as by type (technical, data, community). The spreadsheet of the recommendations is available to all past breakout workshop chairs, and there is a large amount of data for which no statuses have been displayed. Cara strongly encouraged everyone to look through the spreadsheet, even if they were not a session chair, but were involved in the session.

We wish to give an update on the status of the recommendations at the next IOCS meeting and to show a recap from 2013 to 2023. To do this, we need consensus on what has been done.

Cara recommended that the session chairs for the upcoming IOCS BW sessions should look at the recommendations for previous breakout sessions on their topics so that they can see what has been recommended and what has already been done, and maybe how to address the open ones, rather than only add new ones.

Shubha asked whether space agencies look at these recommendations and take them into account when they plan their future missions and roadmaps. Cara indicated that this might vary across the agencies. David asked about a recommendation register, that agencies and others can regularly consult and update if actions have been taken. Cara indicated that this would be useful. We need a transparent way to show that the IOCS breakout workshops are meaningful.

Marie-Helene said that ESA values the community recommendations. She indicated that it will be important to have some traceable way to refer to the recommendations, for example a workshop recommendation paper published on the website. Cara indicated that all the recommendations are published in the IOCS reports. These reports are generated after every IOCS meeting. The information is referenceable, and available on the IOCCG website. However,

there clearly needs to be a more obvious area where these recommendations live, if people are unaware of the reports. Shubha asked whether the final document could be made public. Cara indicated that the statuses need to be updated first, to have an accurate representation of the progress. Laura Lorenzoni suggested that the space agencies could take the recommendations and map them to things they have funded in the past. Shubha indicated that this would be a task for the space agencies. Raisha suggested that the agency representatives could use the existing spreadsheet and go through and fill out which ones have already been taken into account and funded by the agencies. Cara agreed that the agencies can sort the table and write in whether they have considered/funded a recommendation. Shubha asked the space agency representatives if they would be willing. Marie-Helene and Laura indicated that they would. Ewa also indicated that it is good as it will show how agencies are addressing the community needs. Laurent Guigni also agreed.

Action 27/8: Marie-Helene, Laura Lorenzoni, Laurent Guigni, Hiroshi Murakami to go through the [Previous IOCS BW Recommendations](#) document and update the comments with whether the item has been included for agency funded

Action 27/9: IOCCG Project Office to share the IOCS recommendation database on the IOCCG website when completed.

5.2 Breakout workshop session proposals

A total of 7 proposals for breakout workshops (BWs) were submitted for the IOCS-2023 meeting. The breakdown per theme is shown below:

Theme: New and emerging technologies: this includes new technologies related to observational platforms, sensors, algorithms, capabilities, and in-situ measurements

1. Workshop to take inventory of current validation activities (Chairs: Lachlan McKinna, Jeremy Werdell)
2. Lidar (Light detection and ranging) (Chairs: Cédric Jamet, Davide Dionisi, Peng Chen)
3. Ocean Colour Satellite Sensor Calibration TF (Chairs: Gerhard Meister, Ewa Kwiatkowska)

Theme: Cool new ways of examining ecosystem function and change from ocean colour, including carbon from space

4. Mapping between Essential Biodiversity Variables and Essential Ocean Variables (Chairs: Victor, Martinez Vicente, Frank Muller-Karger, Alice Sococcolato, Emmanuele Organelli)
5. Beyond Chlorophyll-a: New trophic state indicators for optically complex waters (Chairs: Daniel Odermatt, Michael Sayers, Astrid Bracher)

Theme: Societal value and Impacts of ocean colour, including economic valuations, linkages with other essential climate variables, value to industries, and impacts on sectors including fisheries, aquaculture, and coastal and marine pollution

6. Enhancing the value of ocean color for societal benefit (Chairs: Veronica Lance, Ryan Vandermeulen)
7. EO in Support of Water Quality Users (Chairs: Merrie Neely, Emily Smail)

All the proposals were approved.

With room for 2 more BWs, the Committee discussed topics that could be added. It was finally agreed to add a session on using OCR to address the land to ocean aquatic continuum and implications for ocean carbon. Hubert Loisel and Claudia Giardino volunteered to chair. The committee also agreed on a session to discuss the observed biases in OCR (potential sources, and mitigation strategies), but expanded the scope to include issues related to (and progress towards) achieving long-term consistency in ocean color data products across missions. Emmanuel Boss indicated that Brian Barnes and Kelsey Bisson had agreed to chair this session. Members suggested, as the two volunteer chairs are US-based, that a chair from another country should be added (Hiroshi Murakami was suggested, but did not immediately agree). The session speakers should reflect the international diversity of the meeting.

Shubha asked about diversity in the other sessions. Raisha indicated there was one session that was geared at state/local representatives, and that it was fine to have a session that was more geared towards the host of the IOCS, since the meeting rotates. Menghua indicated that once we finalize the sessions and workshops, we should receive contributions from different countries and groups that join the session, which will widen the session discussions. Menghua also suggested that if anyone has suggestions for potential speakers, it would be good to send those directly to the session chairs so that they can consider them. Shubha agreed and reiterated that these would be suggestions and not recommendations, as it is the discretion of the chairs to make the final selection.

It was noted that the meeting is not equipped to be hybrid, but that BW chairs could include a few remote presentations if they so desired and had the capacity to do so.

Ewa indicated that the topic on Ocean Colour Satellite Sensor Calibration is an on-going topic under the task force, and for which they wish to always have a BW during future IOCS meetings.

Action 27/10: IOCCG Project Office to communicate to IOCS BW chairs that we wish to engage as geographically diverse an audience as possible, and that this is recommended for speakers within the breakout workshops.

5.3 Keynote speakers

The preliminary list of keynote speakers chosen by the organising committee was shared for feedback from the group. It was also suggested to review keynote speakers in comparison to other IOCS and Ocean Optics conferences, so that the same people are not invited each time. Shungu suggested a speaker on plastic. It was agreed that a speaker on the history of ocean colour would be welcomed. Other suggested topics included the fusion of active and passive remote sensing, and inviting someone from the TARA Ocean expeditions with application to future efforts and how the community can use the data.

Suggestions for early-career speakers as well as those originating from outside of the USA or Europe were especially requested. Names of speakers were suggested from the group or put in the meeting chat.

Action 27/11: IOCCG Committee members to send suggestions for keynote speakers for the next IOCS meeting, as soon as possible.

5.4 Associated training workshops & side meetings

Descriptions of five training workshops were received by the IOCCG Project Office to date to be associated with the upcoming IOCS meeting. These included one all-day training by SeaDAS, and four half-day training courses by NOAA (CoastWatch), EUMETSAT (HyperCP, Data processing with OLCI) and VITO (MAPEO-water drone data processing platform). Subsequently, there would be three workshops running concurrently on the day before the IOCS, 13 November 2023.

The final locations of the training courses have not yet been determined. The entire second floor of the USF Student Center has been reserved for the IOCS meeting, but additional meeting spaces will be secured for the training workshops to allow for a higher capacity of participants.

6.0 Next IOCCG Committee Meeting

6.1 Next Committee Meeting, IOCCG-28

Carolina Tauro presented an offer by CONAE to host the next IOCCG Committee meeting in Argentina in the first half of 2024. This was accepted. The IOCCG-28 Committee meeting will be held at the Centro Espacial Teófilo Tabanera CETT, located in Córdoba, Argentina, and hosted by CONAE. The proposed date for the meeting is any time after 1 April 2024.

7.0 Any other business

7.1 Request for hard copies of Curt Mobley's 2022 Oceanic Optics Book

It was agreed that hard copies of the Ocean Optics Book would not be printed, as 1) the cost is prohibitive, and 2) the need is too low, given that the book is freely available on the IOCCG website.

7.2 Final discussion on the aquatic carbon roadmap

Marie-Helene Rio got feedback from Shubha, Robert, Cecile, Hubert and others that provided support to shape the slides that she will present at the CEOS SIT meeting, specifically to make the case for the aquatic carbon roadmap. The slides presented were not final, and were in draft for comment. The presentation included the following key points:

- The importance of the global carbon cycle, and that it's not just about ocean carbon being useful to ocean carbon budget assessment but really insisting on the fact that there is cost to the ocean from absorbing CO₂ emissions. This cost includes the strong impact on phytoplankton, calcium carbon cycles, biodiversity and higher trophic levels, so addressing the ocean carbon sink needs to take the larger picture of the impact on marine life and ecosystems into account.
- The context of the aquatic carbon roadmap in the context of the other CEOS roadmaps and the CEOS strategy, with a need to provide a 3rd leg to the strategy to complement the first two.
- The timeline for the roadmap
- The content of the roadmap, including processes that can be tracked by remote sensing and those that cannot, and also including the large uncertainties and knowledge gaps that still exist and need to be better understood and contextualized. These gaps include freshwater production, land/ocean fluxes, the impact of climate-related modifications to the marine environment to biological carbon fluxes.
- An emphasis that the roadmap covers all horizontal and vertical dimensions of the ocean, as well as all components of the Earth System for assessing how long the ocean can continue to take up CO₂
- Main objectives of the roadmap, including providing a framework for long-term coordination, serving as a guiding vision for that coordination, being an effective means of communication to society, and addressing basic observation continuity.
- The need for support from CEOS for coordination activities as we progress with the roadmap.

Marie-Helene asked for further input, especially related to challenges that we can identify. Shubha indicated challenges related to resources, as well as capacity-building in order to have a sufficiently large expert pool for the future.

Emmanuel Boss suggested maybe adding a slide for technology advancement needed to address the science. He asked if the roadmap could be used as the basis for requesting from CEOS the need for new ocean missions. Marie-Helene indicated yes. She said that the roadmap helps to define what the community would need in order to address the questions in the long-term.

Shubha asked about consultation for development of the roadmap. Marie-Helene indicated that there is a session on the IOCS about getting community input for the aquatic carbon roadmap, and feedback from the IOCS will be included.

Shubha suggested perhaps adding an extra slide about the timeliness of the roadmap, as there are hyperspectral sensors and other new possibilities for exploring new areas. Ewa suggested that, within CEOS, the activities of the roadmap will overlap with the activities of multiple agencies, and we could state that the agencies should plan for these efforts as guided by the roadmap.

Hubert indicated that it is important to say that we all agree on what is presented. Ewa reminded the group that they are presenting on behalf of the OCR-VC, so all agencies under the OCR-VC (and IOCCG) are already contributing to this effort. Marie-Helene indicated that in

addition to agreement, the agencies would need to dedicate/contribute resources. ESA and NASA already have plans that align with the roadmap. Other agencies may need to respond on whether they will prioritize the effort, and indicate the resources required.

The final set of slides will be sent around for feedback to capture the common view of the IOCCG.

***Action 27/12:** Marie-Helene to send the final slides of the CEOS SIT Meeting to the IOCCG Committee, and space agencies representatives to respond directly with an endorsement.*

8.0 Closing

Updates on the ocean colour activities within the agencies, which were not given during this meeting, will be done during the IOCS meeting in November. Shubha Sathyendranath thanked everyone for contributing to the lively discussions over the four days, and closed the virtual meeting.

Appendix I: LIST OF VIRTUAL PARTICIPANTS, IOCCG-27

IOCCG Members

	Affiliation
Baird, Mark	- CSIRO, Australia
Boss, Emmanuel	- University of Maine, USA
Brando, Vittorio	- CNR-ISMAR, Italy
Ciotti, Aurea	- Universidade de São Paulo, Brazil
Dogliotti, Ana	- IAFE/CONICET, Argentina
Giardino, Claudia	- CNR-IREA, Italy
Giugni, Laurent	- CSA, Canada
He, Xianqiang	- Second Institute of Oceanography, China
Hu, Chuanmin	- University of South Florida, USA
Kim, Wonkook	- Pusan National University, South Korea
Kwiatkowska, Ewa	- EUMETSAT, EU, Germany
Loisel, Hubert	- Université du Littoral, France
Lorenzoni, Laura	- NASA HQ, USA
Malthus, Tim	- CSIRO, Australia
Mélin, Frédéric	- EU Joint Research Center, Italy
Murakami, Hiroshi	- JAXA EORC, Japan
Rio, Marie-Hélène	- ESA/ESRIN, Italy
Sathyendranath, Shubha (Chair)	- Plymouth Marine Lab, UK
Tauro, Carolina	- CONAE, Argentina
Wang, Menghua	- NOAA/NESDIS/STAR, USA
Wilson, Cara (past-Chair)	- NOAA/NMFS, USA
Werdell, Jeremy	- NASA GSFC, USA

IOCCG Project Office

Lovindeer, Raisha	- IOCCG Scientific Officer, Canada
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Invited Participants

Antoine, David (past-Chair)	- Curtin University, Australia
Bracher, Astrid (Monday)	- Alfred-Wegener-Institute, Germany
Brewin, Bob (Tuesday)	- University of Exeter, UK
Concha, Javier A. (observer)	- ESA/ESRIN, Italy
Costa, Maycira (Monday)	- University of Victoria, Canada
Frouin, Robert	- SIO/UCSD, USA
Garaba, Shungu	- University of Oldenburg, Germany
Ibrahim, Amir (Wednesday)	- NASA GSFC, USA
Jackson, Thomas (Tuesday)	- Plymouth Marine Lab, UK
Jamet, Cédric	- Université du Littoral Côte d'Opale, France
Moore, Tim (Tuesday)	- Harbour Branch Oceanographic Institute, USA
Rousseaux, Cecile (Monday)	- NASA GSFC, USA
Yoder, James (past-Chair)	- Woods Hole Oceanographic Institution, USA

Apologies

Bernard, Stewart (past-Chair)	-	SANSA, South Africa
Bontempi, Paula	-	University of Rhode Island, USA
Devred, Emmanuel	-	Bedford Institute of Oceanography, Canada
Dierssen, Heidi	-	University of Connecticut, USA
Lifermann, Anne	-	CNES, France

Antoine, David (absent Thurs)

Brando, Vittorio (absent Mon, Wed, Thurs)

Dogliotti, Ana (absent Tues)

Supporting Documentation:

<https://ioccg.org/ioccg-27-supporting-documentation/>

Appendix II: List of Actions: IOCCG-27 Committee Meeting

Action	Brief Description	Status
27/1	Ewa Kwiatkowska to organize with Maycira Costa a meeting with Arnold Dekker and/or others leading the Aquatic ARD effort to confirm the way forward, indicating that IOCCG wishes to contribute towards this document.	Open
27/2	IOCCG Project Office to communicate to the Ocean Carbon TF leads that the scope should include processes within the ocean.	Closed
27/3	IOCCG Project Office to advertise the review process for IOCCG Reports to encourage uptake as a peer-review document.	Open
27/4	IOCCG Project Office to communicate to WG chairs that their proposals have been approved and to pass on the comments from the meeting (including the chat).	Closed
27/5	Ewa Kwiatkowska to have discussions about passing on responsibilities, perhaps of one of the task force leads	Closed
27/6	IOCCG Project Office in conjunction with David Antoine to draft wording for call for proposals to the community for potentially hosting the summer lecture series from 2024 onwards.	Closed
27/7	IOCCG Project Office to reach out in a joint email to those working on the topic of seasonal bias and give them the opportunity to form an informal group to share ideas and findings.	Open
27/8	Marie-Helene, Laura Lorenzoni, Laurent Guigni, Hiroshi Murakami to go through the Previous IOCS BW Recommendations document and update the comments with whether the item has been included for agency funded	On-going
27/9	IOCCG Project Office to share the IOCS recommendation database on the IOCCG website when completed.	Open
27/10	IOCCG Project Office to communicate to IOCS BW chairs that we wish to engage as geographically diverse an audience as possible, and that this is recommended for speakers within the breakout workshops.	Closed
27/11	IOCCG Committee members to send suggestions for keynote speakers for the next IOCS meeting, as soon as possible.	Closed
27/12	Marie-Helene to send the final slides of the CEOS SIT Meeting to the IOCCG Committee, and space agencies representatives to respond directly with an endorsement	Closed