

Annual Report to SCOR International Ocean Colour Coordinating Group (IOCCG) Affiliated Project

Reporting Period: 1 July 2022 – 30 June 2023

Prepared by: Raisha Lovindeer, IOCCG Scientific Coordinator

1. Background

The International Ocean Colour Coordinating Group (IOCCG) has been an affiliated project of SCOR since 1997, and is an associate member of the Committee on Earth Observation Satellites (CEOS). Committee members of the IOCCG are representatives from space agencies around the world as well as from the ocean colour research community. IOCCG promotes development and applications of science and technology that underpin remote sensing of ocean colour 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).

2. IOCCG Committee & Rotations

The IOCCG is currently chaired by Shubha Sathyendranath (Plymouth Marine Lab, UK), who took over the role from Cara Wilson (NOAA, USA) in June 2022. Each Chair is meant to serve for 3 years, and then remain on the Committee for another 3 years as Past-Chair. This helps support the in-coming Chair and smooth transition.

The IOCCG Committee consists of representatives from the space agencies and the scientific ocean-colour community. They are selected to reflect a balance of providers and users of ocean-colour data, as well as geographical locations. Sponsoring-agency representatives are appointed by their agencies, and they comprise the IOCCG Executive Committee (designated by **bold font** in the rotation list below), which has general oversight of the activities of the IOCCG Project Office, including approving all finances. Their rotation is determined by their respective agency. Committee members serve one 3-year term, which can, on occasion for specific purposes, be renewed for one additional term. Rotation of members ceased during the COVID-19 Pandemic because of a lack of normal activity and no in-person Committee meetings. Regular rotations have since resumed.

The following Committee Member(s) rotated off during the report period:

- Stewart Bernard - SANSa, South Africa
- Emmanuel Boss - University of Maine, USA
- **Anne Lifermann** - **CNES, France**

The following new Committee Member(s) were added:

- Mark Baird - CSIRO, Australia
- **Steve Groom** - **NCEO, UK**
- **Annick Sylvestre-Baron** - **CNES, France**

The full Committee is listed in Table 1, along with their expected rotation date.

The Committee meets annually to discuss ocean colour science and applications; review the work of existing scientific working groups and task forces, and decide on proposals for new ones; and review and plan for upcoming capacity building initiatives and outreach events, including research scholarships, the IOCCG Summer Lecture Series, and the International Ocean Colour Science (IOCS) meetings. The 27th IOCCG Committee Meeting was held virtually, from 13 - 16 March, 2023. A copy of the [minutes of the IOCCG-27 Committee meeting](#) is available on the IOCCG website.

Table 1: Current IOCCG Committee Members, serving from 2023 onwards. Members who are agency representatives and serve on the Executive Committee have no rotation year listed, as their rotation is determined by their agency.

Committee Members	Agency	Rotation Year
Ana Dogliotti	IAFE/CONICET, Argentina	2024
Annick Sylvestre-Baron	CNES, France	-
Aurea Ciotti	Universidade de São Paulo, Brazil	2025
Cara Wilson	NOAA/NMFS, USA	2025, Past-Chair
Carolina Tauro	CONAE, Argentina	-
Chuanmin Hu	University of South Florida, USA	2026, 2nd term
Claudia Giardino	CNR-IREA, Italy	2025
Emmanuel Devred	Bedford Institute of Oceanography, Canada	2024
Ewa Kwiatkowska	EUMETSAT, EU, Germany	-
Frédéric Mélin	EU Joint Research Center, Italy	-
Hiroshi Murakami	JAXA EORC, Japan	-
Hubert Loisel	Université du Littoral, France	2024, 2nd term
Jeremy Werdell	NASA GSFC, USA	2026
Joo-Hyung Ryu	KIOST, South Korea	-
Laura Lorenzoni	NASA, USA	-

Laurent Giugni	CSA, Canada	-
Marie-Hélène Rio	ESA/ESRIN, Italy	-
Mark Baird	CSIRO, Australia	2026
Menghua Wang	NOAA/NESDIS/STAR, USA	-
Milton Kempel	INPE, Brazil	-
Paula Bontempi	University of Rhode Island, USA	2025
Prakash Chahaun	ISRO, India	-
Shubha Sathyendranath	Plymouth Marine Lab, UK	2028, Chair
Steve Groom	National Centre for Earth Observation, UK	-
Tim Malthus	CSIRO, Australia	-
Vittorio Brando	CNR-ISMAR, Italy	2025
Wonkook Kim	Pusan National University, South Korea	2025, 2nd term
Xianqiang He	Second Institute of Oceanography, China	-

3. IOCCG Project Office & Finances

3.1. Status of the Project Office

The IOCCG Project Office is located at the Bedford Institute of Oceanography, Canada. It is managed by the IOCCG Scientific Coordinator, Raisha Lovindeer, who was promoted to this role after the retirement of Venetia Stuart on the 1st of January 2023. Venetia had previously managed the IOCCG Project Office solo, for 25 years, and then jointly with Raisha since May 2021.

The Scientific Coordinator assists the IOCCG Chair in coordinating the activities of the group as a whole, including managing the finances, planning annual meetings, training courses, the IOCS meetings and workshops, liaising with working groups and task forces, editing and mailing IOCCG reports, and maintaining the IOCCG mailing list, website, and social media feeds.

3.2. Status of Finances

The IOCCG Executive Committee meets once or twice a year to discuss IOCCG finances, membership rotations, and some program-related matters arising from the Committee meeting. The Executive Committee also approves the IOCCG budget for the coming year.

The IOCCG operates on a very lean budget, which funds administrative costs, Committee meetings, scientific activities including kick-off workshops for working groups and the printing and mailing of IOCCG reports, as well as capacity building and outreach activities, which includes the biennial Summer Lecture Series and biennial IOCS meeting (which

alternate), the annual IOCCG Platt Scholarship, and maintenance of the IOCCG mailing list and website for information access. These activities are funded by the IOCCG sponsoring agencies who are represented by the Executive Committee members. For 2022, the total income, including in-kind contributions for office space at the Bedford Institute of Oceanography, was \$192,523. Total expenditure was \$191,495. Out of necessity, the IOCCG maintains, from previous years of funding, a cash cushion of above \$60,000 to ensure future expenses. This is needed as a high proportion of funding comes from NASA grants (administered through SCOR), for which claims are deferred until after expenses have been paid. In collaboration with SCOR, IOCCG has one NASA grant currently on-going, and one grant proposal in review for the 2023-2026 grant period.

4. Outreach & Capacity Building Accomplishments

4.1. IOCCG Summer Lecture Series

The 2022 edition of the advanced [IOCCG Summer Lecture Series](#) (SLS) covering topics at the frontier of ocean optics and ocean colour science took place from 18 – 29 July 2022 at the Laboratoire d’Océanographie de Villefranche, France, which has hosted the SLS from its inception. A total of 145 applications were received from scholars all over the world, working on a range of oceanographic remote sensing topics. The selection process was exceedingly competitive this year, with many students having a solid prerequisite of foundational training in ocean colour science. Priority was given to students who demonstrated a clear gap in their knowledge for which the course would be a good filler, and for whom training and networking opportunities in ocean colour science at their host institutions were limited. A total of 23 students attended the two-week course, which was run by 11 volunteer lecturers who offered their time and expertise to train the students.

After the 2022 edition, which marked the 10 year anniversary of the course (started summer 2012), the course coordinator, David Antoine (initially Laboratoire d’Océanographie de Villefranche, France, now Curtin University, Australia) requested that the course be transitioned to a new coordinator and host. The IOCCG put out a call for expressions of interest to coordinate and host future editions of the SLS. Responses to this call are currently being reviewed to select the new location of the SLS for 2024 and beyond.

4.2. Launch of the annual IOCCG Platt Scholarship

The IOCCG opened applications for its annual [Trevor Platt Memorial Scholarship](#), in honour of the late Trevor Platt in August 2022. Though the scholarship had been planned for earlier years, it was postponed because of the COVID-19 pandemic, as the award involves travel for one developing country national to a developed country for research or training. Due to the inability to have the award in 2020-2021, [two scholars](#) were selected for the inaugural award, and were announced in early 2023. The scholars, selected from Mexico and India, will share

the results of their research at the IOCS meeting in November, and will also contribute articles to the IOCCG news bulletin.

5. Scientific Accomplishments

Various aspects of ocean colour science, technology and its applications are advanced through IOCCG scientific working groups and task forces.

Task Forces operate on longer timelines.

5.1. IOCCG Working Group Accomplishments

Working groups operate on a timescale of 2 - 4 years and publish their findings as an IOCCG Report. Reports are made available through the IOCCG website and the OceanBestPractises (OBP) repository, which is maintained by IODE of UNESCO-IOC. As IOCCG Coordinator, Venetia Stuart was the series editor for 20 such reports, which are now Volume I of the IOCCG Report Series. Raisha Lovindeer is the new series editor for Volume II.

A call for working groups was issued and two new working groups were approved at the last IOCCG Committee meeting. There are now four active scientific working groups from which reports (or other output) should be generated within the next 2-4 years. Their accomplishments for the 2022-2023 reporting period are highlighted below.

5.1.1. [Working Group on Conducting benthic reflectance measurements](#)

This working group, chaired by Heidi Dierssen (University of Connecticut, USA), is making steady progress towards an IOCCG Report on the topic, and submitted their working outline and a draft chapter on the theory in March 2023 for review by the IOCCG Committee. The report is proposed to have 17 chapters that cover the basics of benthic reflectance (including overviews of theory, instrumentation, measurements and processing), handling spectral databases and metadata, emerging technology, difference in scale and habitat, and applications to ecology, ecosystem services, marine geology and archeology, and global change assessment. The working group currently meets online every month.

5.1.2. New [Working Group on Ocean primary production from space](#)

This working group was approved in March 2023 at IOCCG-27 Committee Meeting. It is chaired by Robert Brewin (University of Exeter, UK), and is planning a kick-off meeting for November 2023, in conjunction with the IOCS meeting. The working group will discuss and evaluate new methods and technologies for measuring primary production at sea, as well as approaches

designed to harness multispectral and hyperspectral ocean color datasets anticipated from new missions. They aim to harness lessons learned from recent large multi-institutional and multidisciplinary programs, long-term observational programs to improve the accuracy of satellite primary production estimates, which can then be included in large-scale estimates of the carbon budget, like modeling and estimates for IPCC reports. Their output is anticipated to be an IOCCG scientific report, which will summarize these activities, including discussions and assessments of the socio-economic costs associated with inaccuracies of primary production estimates.

5.1.3. [New Working Group on Classification of optical water types in aquatic radiometry](#)

This working group was approved in March 2023 at the IOCCG-27 Committee Meeting and is co-chaired by Thomas Jackson (Plymouth Marine, UK) and Timothy Moore (Florida Atlantic University, USA). The group is planning a kick-off meeting for November 2023, in conjunction with the IOCS meeting. As no single perfect algorithm works optimally across all optical aquatic conditions or *water types*, there has been a move towards a broader optical water type classification approach and algorithm blending in recent years. This approach acknowledges that multiple optimal algorithms exist, and that for each, the most suitable optical environments must be defined. The group plans to review current approaches to optical clustering and class assignment from open ocean to coastal waters, including methods of comparing results from various clustering studies. The goal is to recommend a common baseline and generalised approach from which ocean colour scientists can build, and identify needs and challenges for classification of hyperspectral data. They also aim to provide open code tools for users alongside reference datasets for algorithm testing and comparison, and will summarise their work in an IOCCG report.

5.2. IOCCG Task Force Accomplishments

Task Forces operate on a longer timescale, and are semi-permanent. They address issues that require ongoing expertise and help to facilitate on-going inter-agency collaboration, and exist until the need for their formation is met. Their progress and goals are reviewed annually at IOCCG Committee meetings. The IOCCG approved two new task forces at the last IOCCG Committee meeting. There are now five active task forces. Their accomplishments for the 2022-2023 reporting period are highlighted below.

5.2.1. [Task Force on Ocean Colour Satellite Sensor Calibration](#)

The IOCCG Task Force on Satellite Sensor Calibration is co-chaired Ewa Kwiatkowska (EUMETSAT, Germany) and Gerhard Meister (NASA, USA), and brings together global experts to collectively address the challenging requirements of calibrating ocean colour instruments, by sharing their multi-mission experience. Some measurable benefits of the task force to date:

- PACE providing valuable lessons learned to other missions, including Copernicus Next Generation
- SeaWiFS, MODIS, VIIRS lunar observations standards taken up by other missions, e.g. Sentinel-3
- Community lunar model: GSICS implementation of the ROLO (GIRO)
- Sentinel-3 OLCI in-flight diffuser characterization via yaw maneuvers following MODIS and VIIRS experience
- Benefits of Sentinel-3A/B tandem phase demonstrated for instrument cross-calibrations
- Improved pre-launch calibration approaches via shared experience from similar sensors

5.2.2. [Task Force on Remote Sensing of Marine Litter & Debris](#)

The IOCCG Task Force on Remote Sensing of Marine Litter and Debris (RSMLD) was established to coordinate the advancement of remote sensing technology to detect and observe plastic litter in marine and aquatic environments. The task force members met contributed to several conferences in 2022, including

- Living Planet Symposium 2022: Session A8.08 *Advances and EO Applications in Remote Sensing of Marine Litter and Debris*, May 2022
- 7th International Marine Debris Conference 2022: Session TS-3.5 *Satellite and Airborne Remote Sensing of Marine and Coastal Litter*, Sept 2022
- 2022 Brest Workshop on *Marine Litter: Solutions for a Cleaner Ocean*, Sept 2022

To date, the group has generated 126 peer reviewed papers related to remote sensing of marine litter and debris, 20 datasets available through the [IOCCG bibliography for data sharing](#), and highlighted 11 online repositories and databases, available as open-access for the remote sensing of marine litter community.

5.2.3. Task Force on Ocean Colour System Vicarious Calibration

The Task Force on Ocean Colour System Vicarious Calibration (OC-SVC) was formed based on a recommendation from the IOCCG Committee. The chairmanship of the task force changed, as Ewa Kwiatkowska (EUMETSAT) rotated off and Giuseppe Zibordi (currently at NASA-GSFC) rotated on, to co-chair with Carol Johnson (NIST). The membership of the task force is being cemented, with some members of the preceding working group on long-term vicarious adjustment in ocean colour sensors transitioning to the task force, and new members recommended to join. The first in-person meeting of the task force is planned for November 2023, in conjunction with the IOCS meeting.

5.2.4. New Task Force on Hyperspectral Remote Sensing of the Ocean

The Task Force on Hyperspectral Remote Sensing of the Ocean was formed based on a decision from the IOCCG Committee. The chairs for the task force are Astrid Bracher (AWI, Germany) and Jeremy Kravitz (NASA-AMES, USA). The terms of reference for the task force were discussed at the IOCCG-27 Committee meeting in March 2023. Additional members are being added to the task force team, and their first virtual meetings planned for 2023.

5.2.5. New Task Force on Ocean Carbon from Space

The Task Force on Ocean Carbon from Space was formed based on a recommendation emerging from the 26th IOCCG Committee meeting and the Carbon from Space workshop. The task force is chaired by Cecile Rousseaux (NASA-GSFC, USA) and Jamie Shutler (University of Exeter, UK). It will provide a resource of expert advice across all areas of satellite observations relevant to carbon. Although housed within IOCCG, it will operate in partnership with other relevant expert groups (e.g. GHRSSST for temperature), climate teams (e.g. on sea state), or individual experts with knowledge specific to the topic (e.g. satellite observations of atmospheric gases over the ocean). The task force aims to encourage the uptake of climate quality satellite data records for all methods of quantifying ocean carbon, provide support to annual assessments and related workshops on carbon, including IPCC efforts, and help support the aims of CEOS Carbon Strategy.

6. Scientific Development and Implementation

In addition to the on-going work of the new and pre-existing scientific working groups and task forces, highlighted above, other plans for the scientific development and implementation of the IOCCG program over the next two to three years are highlighted below.

6.1. IOCCG Activities on the CEOS 2023-2025 Work Plan

The IOCCG agencies are represented in CEOS through the CEOS Ocean Colour Radiometry Virtual Constellation (OCR-VC). The OCR-VC is chaired by Ewa Kwiatkowska (EUMETSAT, Germany) and Marie-Hélène Rio (ESA-ESRIN, Italy). The IOCCG activities included on the CEOS 2023-2025 Work Plan are detailed below.

6.1.1. Aquatic Carbon Roadmap

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 roadmap builds upon the Ocean Carbon from Space workshop, the International Network for Sensor Inter-comparison and Uncertainty assessment for Ocean Colour Radiometry (INSITU-OCR) white paper, and the special issue in *Earth Science Reviews* on aquatic carbon stocks and fluxes. Included in the development of the roadmap will be the following activities:

- Community involvement from the IOCS-2023 Breakout Workshop session: Global carbon budget for the land to ocean aquatic continuum (LOAC) from remote sensing, November 2023
- Community involvement from the Blue Carbon Workshop planned for early 2024

Chairs from both the IOCCG task force on ocean carbon from space and the IOCCG working group on ocean primary production from space form the scientific leads on the aquatic carbon roadmap activities, and will be heavily involved in its development.

6.1.2. Aquatic Reflectance Product Family Specification

Over the next few years, the OCR-VC will also contribute to the development of the Aquatic Reflectance Product Family Specification for CEOS Analysis-Ready Data (ARD). This product family specification will bridge the gap between the Land Reflectance Product Family, which includes some coastal waters, across the continuum to seas and the open ocean.

6.2. Development of New Protocols for Bio-optical In Situ Measurements

The [IOCCG Protocol Series](#) are peer-reviewed *Ocean Optics & Biogeochemistry Protocols for Satellite Ocean Colour Sensor Validation*. They are vetted by and for the international community, after a 60 or 90 day review period. The protocol documents include updated versions of the *NASA Ocean Optics Protocols for Satellite Ocean Color Sensor Validation* as well as new material. Over the next three years, new protocol documents are anticipated that will focus on phytoplankton taxonomy and imaging, and on carbon.

7. Contribution to SCOR Activities

IOCCG's affiliation to SCOR is critical in helping the IOCCG secure and manage funding from NASA for its programme. IOCCG currently has one active NASA grant (2019-2022, extended to 2023/4) in collaboration with SCOR, and another grant proposal in review (2023-2026). These grants help to further the scientific program of the IOCCG. The IOCCG Project Office submits quarterly expenditure from these grants to the SCOR secretariat.

Several of the scientific missions of IOCCG working groups and task forces overlap and complement activities within SCOR. These include synergies between the activities of the IOCCG task force on Remote Sensing of Marine Litter & Debris and the International Marine Debris Observing System (IMDOS) which emerged from the SCOR Working Group (153) on Floating Litter and its Oceanic Transport Analysis and Modelling (FLOTSAM). The current IOCCG focus on ocean carbon—through the newly formed task force ocean carbon, the Ocean Primary Production working group, and the CEOS aquatic carbon roadmap—also overlaps with SCOR's key interest on the ocean carbon budget and continues to highlight the synergy between IOCCG and SCOR.