

## **IOCCG Annual Report to SCOR**

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The International Ocean-Colour Coordinating Group (IOCCG) is an Affiliated Program of SCOR, and an Associate member of the Committee on Earth Observation Satellites (CEOS). The IOCCG is comprised of representatives from space agencies around the world as well as members of the research community, and addresses technological and scientific issues related to ocean and in-land water colour radiometry through scientific working groups and task forces. IOCCG also promotes capacity building through advanced training courses, and resources made available on our website at [ioccg.org](http://ioccg.org). The IOCCG also helps to ensure the continuity and quality of the ocean-colour data stream through the CEOS Ocean Colour Radiometry-Virtual Constellation (OCR-VC).

IOCCG's affiliation to SCOR is critical in helping the IOCCG secure and manage funding from NASA for its programme. The IOCCG was chaired by Cara Wilson (NOAA, USA) up until June 2022, and is now chaired by Shubha Sathyendranath (PML, UK) (see section 6 below). The IOCCG Project Office is located at the Bedford Institute of Oceanography, Canada. The project office is staffed by Venetia Stuart and Raisha Lovindeer, who are both working part-time and remotely.

### **1. IOCCG Scientific Working Groups**

IOCCG scientific working groups are established to investigate various aspects of ocean colour science, technology and its applications. These working groups are relatively short-lived (2-4 years) and their findings are published in the form of an IOCCG Report, available through the IOCCG website, as well as the OceanBestPractises (OBP) repository (maintained by IODE of UNESCO-IOC). All IOCCG reports are easily accessible and citable using the digital object identifier (doi) assigned by OBP. There are currently two active working groups, though the working group on *Atmospheric Correction Over Turbid Waters* is expected to produce the first technical report, rather than a standard IOCCG Report.

#### **1.1 IOCCG Scientific Working Group on Benthic Reflectance**

An IOCCG working group on Benthic Reflectance, led by Heidi Dierssen (University of Connecticut, CT) held their kick-off meeting from 29 – 31 March 2022. Benthic reflectance is a property describing the colour of the bottom boundary (seafloor, coral, algae, etc.) in aquatic ecosystems. It is an essential parameter for mapping habitats in optically shallow water using remote sensing techniques and has applications in ecology, ecosystem health and function, global change, conservation, marine geology and archeology.

The working group aims produce an IOCCG report that covers an overview of instrumentation and methods, examples of benthic reflectance across different scales and habitats, environmental influences on the measurements, applications and emerging technologies. They aim to fill the gap on recommendations for the best practices of methods and instrumentation for benthic reflectance measurements and potential uncertainties, with a goal to:

- document how these different methods work
- characterize the uncertainties inherent to the measurements
- provide recommendations as to best practices for each method in order to minimize the uncertainty.
- provide recommendations for relevant metadata to be included for each dataset, and
- possibly recommend practices in field validation for benthic remote sensing.

An ambitious report and an aggressive timeline has been outlined by the team. Further information can be found on the IOCCG website for the [Benthic Reflectance Measurements](#) working group.

## 1.2 IOCCG Scientific Working Group on Atmospheric Correction

The working group on [Atmospheric Correction over Turbid Waters](#) is led by Cédric Jamet (LOG) and aims to provide a comprehensive evaluation of the most common atmospheric correction algorithms used over turbid waters, as well as to provide guidance to end-users on how and where to use specific atmospheric correction algorithms. A total of ten atmospheric correction algorithms are being evaluated using a simulated dataset for sensitivity studies, and the first IOCCG Technical Report is anticipated. The working group is on-going.

## 2.0 IOCCG Scientific Task Forces

In addition to working groups that generate a report and then close, the IOCCG has semi-permanent *Task Forces* to address issues that require ongoing expertise and help to facilitate on-going inter-agency collaboration.

### 2.1 Task Force on 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. Their goal is to maximize the accuracy and temporal and spatial stability of ocean colour radiometry records from individual missions. The Task Force held a virtual meeting In February 2022 in which they discussed updates on the calibration efforts of many different missions and satellite sensors, as well as the application of new calibration methods and new recommendations emerging from CEOS. Presentations from the meeting can be viewed on the [task force webpage](#).

## 2.2 Task Force on Detecting Plastic Marine Debris

The [IOCCG Task Force on Remote Sensing of Marine Litter and Debris](#) (RSMLD) was established last year and has a goal to coordinate the advancement of remote sensing technology to detect and observe plastic litter in marine and aquatic environments. The Task Force is led by Shungu Garaba (University of Oldenburg, Germany), Manuel Arias (Argans Ltd., France), Lauren Biermann (Plymouth Marine Laboratory, UK) and Victor Martinez-Vicente (Plymouth Marine Laboratory, UK) together with four co-chairs from national space agencies (ESA, ISRO, JAXA and NASA).

The Task Force held its second virtual workshop on 7 - 8 March 2022 to present the progress of the group, and to hold an open discussion with Task Force members and external attendees to advance the outcomes of the four Core Topics. The workshop was attended by a total of 101 participants from 18 different countries. The online sessions gave the opportunity to non-members to follow the discussion and contribute by leaving comments and suggestions on online sheets (see sheets for [day 1](#) and [day 2](#)). The IOCCG Project Office gave the welcoming address on the opening day.

The workshop was structured around the four Core Topics: **Technologies** group (coordinated by Victor Martinez-Vicente) has been focusing on the production of a peer reviewed paper on the status of research (i.e., maturity) and potential of different combinations of techniques (passive and active) and platforms to detect marine plastic debris in two scenarios: accumulations on frontal areas and on the shoreline. Leadership of the paper is now with Michelle Gierach (JPL, NASA). During 2021 the group met monthly and is expected to submit this manuscript by end of 2022. **Algorithms and Applications** group (coordinated by Manuel Arias) collected and reviewed a compilation of 136 publications performing a critical analysis of the algorithms used and how they were applied. Publications were sorted by platforms (i.e., satellites, airplanes, drones, mast-based instruments on ground), signal acquired (from visible to microwaves), applications (e.g., river monitoring, beach mapping, floating debris detection, large marine debris patches), and algorithms used. Current research focus is on macroplastic and/or accumulations of marine debris, while little evidence has been reported on capabilities to detect microplastic from any of the assessed platforms. The algorithms used are strongly dependent on the spatial resolution offered by the combination of the sensors and platforms. Satellite approaches are bound to have significant uncertainties due to lack of dedicated bands, relatively low SNR associated to the low resolution versus the scales of marine litter and debris, and water absorption in key bands for plastic detection. **Datasets** group (coordinated by Shungu Garaba) is developing a living report as a roadmap for methods for collecting high quality plastic related data from the current and emerging suite of remote sensing technologies, including classic and sophisticated algorithms, use of machine learning with hyperspectral technologies, and combinations of drone imagery to develop algorithms for the detection of marine litter from satellite imagery. This report will be published as an IOCCG Technical Report. **Interdisciplinary Aspects** group (coordinated by Lauren Biermann, and Madeline Cowell, Ball Aerospace) will create a centralized repository for information in the field of remote sensing of plastics in/on the water. The roadmap to achieve this goal will include a living document on sensors and algorithms, an attempt to grow the RSMLD interdisciplinary science community, and making data and findings accessible in a ready-to-use format for non-expert users and stakeholders.

A detailed report of the talks and topics presented at the workshop for each Core Topic can be downloaded from the IOCCG website at: [https://ioccg.org/rsml-d-news-and-updates/2nd-workshop-rep...-rsml-d\\_march2022/](https://ioccg.org/rsml-d-news-and-updates/2nd-workshop-rep...-rsml-d_march2022/)

### **2.3 New 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, and is chaired jointly by Ewa Kwiatkowska (EUMETSAT) and Carol Johnson (NIST). OC-SVC is a fundamental requirement for all ocean colour missions in order to meet the stringent accuracy requirements for radiometric products and all downstream bio-optical products. The Task Force will help to coordinate SVC infrastructure development and maintenance, including NOAA maintenance of MOBY, NASA development of SVC infrastructure for the PACE mission and EU Copernicus/EUMETSAT development of SVC infrastructure for the Sentinel missions. No meeting of the Task Force has yet occurred, however there are many on-going activities and lessons learned at the agency level, which can be taken up by the group. They plan to meet in late 2022.

## **3.0 IOCCG Protocol Series**

The IOCCG established the IOCCG Protocol Series to publish peer-reviewed Ocean Optics and Biogeochemistry Protocols online. *In situ* optical and biogeochemical in- and above-water measurements are critical for calibration and validation of satellite ocean colour radiometry data products, and for refinement of ocean colour algorithms. The following protocol is in draft form and available on the IOCCG website for comment: [Aquatic Primary Productivity Field Protocols for Satellite Validation and Model Synthesis](#). The document synthesizes measurements of primary productivity, including the essential issues, nuances, definitions, scales, uncertainties, and ultimately best practices for data collection across multiple methodologies

The final draft of [Measurement Protocol of Absorption by Chromophoric Dissolved Organic Matter \(CDOM\) and Other Dissolved Materials](#) (volume 5.0) is being prepared, and the [Particulate Organic Carbon Sampling and Measurement Protocols: Consensus Towards Future Ocean Color Missions](#) (volume 6.0) was published in August 2021 is available on the IOCCG website.

## **4.0 Capacity Building**

### **4.2 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. 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 that the course would fill, 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.

## 5.0 IOCCG Committee Meetings

The 26<sup>th</sup> IOCCG Committee meeting took place from 27-29 June 2022 and was hosted by the European Space Agency at their ESA-ESRIN facilities (Frascati, Italy). The meeting was held in hybrid format with a total of 21 members participating in-person and 22 participating online via video link over the three days of the meeting. Agenda topics included a review of all current IOCCG working groups and task forces, as well as updates from the 12 participating space agencies. Participants engaged in several discussions including the establishment of IOCCG working groups on ocean colour system vicarious calibration, ocean colour hyperspectral missions and carbon-from-space. Other discussions included seasonal biases in ocean colour, requests for full resolution OCR data over coastal waters, generating water quality products from high resolution satellites and establishing an efficient international database of match-up data points.

In January 2022 a virtual IOCCG Executive meeting took place to discuss plans for the year ahead and approve the budget for the coming year. Another IOCCG Executive Committee meeting took place on July 29, 2022, immediately after the Committee meeting to recap IOCCG finances and discuss membership rotation and matters arising from the Committee meeting.

## 6.0 IOCCG Membership (2022)

The IOCCG Committee consists of members drawn from space agencies as well as the scientific ocean-colour community, selected to reflect a balance of both providers and users of ocean-colour data, as well as geographical location. At the IOCCG-26 committee meeting Cara Wilson (NOAA/NMFS) stepped down as chair of the group and was replaced by Shubha Sathyendranath (PML, UK). Regular rotation of Committee members (every ~3 years) has commenced again with Bryan Franz (NASA GSFC) being replaced by Jeremy Werdell (NASA GSFC), and the appointment of an ocean colour modeller (to be announced).

Bernard, Stewart	-	SANSA, South Africa
Bontempi, Paula	-	NASA HQ, USA
Boss, Emmanuel	-	University of Maine, USA
Brando, Vittorio	-	CNR-ISMAR, Italy
Chauhan, Prakash	-	ISRO, India
Ciotti, Aurea	-	Universidade de São Paulo, Brazil
Devred, Emmanuel	-	Bedford Institute of Oceanography, Canada
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
Kampel, Milton	-	INPE, Brazil
Kim, Wonkook	-	Pusan National University, South Korea
Kwiatkowska, Ewa	-	EUMETSAT, EU, Germany
Lifermann, Anne	-	CNES, France
Loisel, Hubert	-	Université du Littoral, France
Malthus, Tim	-	CSIRO, Australia
Mélin, Frédéric	-	EU Joint Research Center, Italy
Murakami, Hiroshi	-	JAXA EORC, Japan
Rio, Marie-Hélène	-	ESA/ESRIN, Italy
Ryu, Joo-Hyung	-	KIOST, South Korea
Sathyendranath, Shubha (Chair)	-	Plymouth Marine Laboratory, UK
Wang, Menghua	-	NOAA/NESDIS/STAR, USA
Werdell, Jeremy	-	NASA GSFC, USA
Wilson, Cara (Past-Chair)	-	NOAA/NMFS, USA