IOCCG-20 Committee Meeting
CNES HQ, Paris, France 3 – 5 March 2015

MINUTES

1.0 Welcome and Opening Session

1.1 Welcome and Introductory Remarks

The Chairman, Stewart Bernard, opened the meeting and thanked everyone for coming to Paris. He expressed his thanks to Juliette Lambin and to CNES for hosting the 20th IOCCG Committee meeting in Paris. New Committee members for 2015 were officially welcomed including Simon Bélanger, Cara Wilson and George Wiafe (unable to attend). The Chair invited a brief tour de table for participants to introduce themselves. Gene Feldman and Zhihua Mao would be stepping down after the meeting and were thanked for their contributions over the years. Xianqiang He would officially replace Zhihua Mao at the next IOCCG meeting, and he was also welcomed. The list of participants is provided as an Annex to the minutes.

Juliette Lambin welcomed participants to Paris and wished everyone a fruitful meeting. She noted that this would be her last IOCCG meeting as she was taking up a new position as head of a department at CNES in charge of radar processing. She introduced Phillippe Escudier, her replacement on the IOCCG Committee, who was warmly welcomed.

1.2 Presentation by CNES Director

Prof Fabienne Casoli, the deputy director of Strategy, Programs and International Relations and the Scientific Director of CNES, provided a brief overview of CNES. There are five main areas of activity in CNES including telecommunication, launchers, science, defence and Earth Observation, employing people in four centers of excellence: the Toulouse Space Center, which designs orbital systems and is the technical center, the Launch Vehicle Directorate, the French Guiana Space Center, and the Head Office in Paris. CNES is the premier contributor to ESA's budget and ESA is CNES's primary partner in numerous programmes. There are also numerous multi-lateral and bi-lateral cooperative programmes with international space agencies. Ocean sciences is of major interest to CNES's Earth observation programs and CNES provides dedicated research funding to supporting a strong ocean colour scientific community.

1.3 Adoption of IOCCG-20 Agenda

The IOCCG-20 agenda was adopted with the addition of a presentation by Andrew Tyler on GloboLakes (agenda item 7.6).

1.4 Adoption of Minutes from IOCCG-19 and Status of Actions

The minutes of IOCCG-19 were approved by consensus. The Chairman summarised the status of actions from the 19th Committee meeting, most of which had either been completed, or would be addressed further during the meeting.

- *Action 19/1:* Vittorio Brando and Suzanne Craig have agreed to take over as chairs for the Coastal Water Algorithm Comparison (CWAC) working group, which will be re-scoped and presented under agenda item 2.3.
- *Action 19/2:* Nick Hardman-Mountford suggested Stuart Phinn as a good initial contact as an expert in coral reef research using ocean colour remote sensing.
- *Action 19/3:* A very successful PFT workshop took place at Ocean Optics in October 2014, sponsored by IOCCG.
- *Action 19/4:* The *in situ* measurement protocols co-ordination activity is moving forward under the leadership of Jeremy Werdell and Paula Bontempi (to be addressed under item 6.5).
- *Action 19/5:* OOPC are coordinating reports on the status of ECVs for the 2015 GCOS Status Report and the 2016 GCOS Implementation Plan. Jim Yoder submitted an update on the ocean colour ECV (agenda item 6.2). Mark Dowell noted that IOCCG would be asked by GCOS to provide input on their implementation plan. IOCCG should get consensus on requirements.
- *Action 19/6:* Potential new chairs for the ECV Task Force will be discussed under agenda item 6.2.
- *Action 19/7:* Ewa Kwiatkowska recommended that the proposed letter to the EC regarding L1A product development and dissemination should be addressed to Mr. Philippe Brunet (Director for Aerospace, Maritime and Defence Industries, DG GROWTH).
- *Action 19/8:* The letter of recommendation from IOCCG to the EC regarding Copernicus data policy will be discussed further under agenda item 4.7 and during the IOCCG Executive Committee meeting.
- *Action 19/9:* The satellite sensor calibration task force will be addressed under item 6.3. A website has been created for the group and the Terms of Reference finalized.
- *Action 19/10:* Giuseppe Zibordi prepared an Excel spreadsheet for mapping current and planned activities of each space agency – this was discussed at the last IOCCG Executive meeting, and will be addressed again under item 6.4.
- *Action 19/11:* Committee members are requested to provide feedback to Milton Kampel regarding proposed bands for the SABIA/MAR mission.

- *Action 19/12:* The sensors page on the IOCCG website has been updated with information provided by Committee members at the last meeting (links for satellite data and missions). Additional inputs welcome.

2.0 Status of IOCCG Working Groups

2.1 Earth Observations in Support of Global Water Quality Monitoring

Steven Greb reported on the IOCCG working group on Earth Observations in Support of Global Water Quality Monitoring, co-chaired by himself, Arnold Dekker and Paul DiGiacomo. He outlined the rationale, goals and visions of the group as well as the overarching objectives. The first meeting of the working group took place at NOAA (9-10 June 2014) where the function, structure and context of the WG were discussed. The report framework centered on three audiences with three different time scales: the short timeframe (0-1 year) addressing societal infrastructure and end users (chapters 1 to 4 of the report), the mid-range (1-5 year) addressing science infrastructure and the research community (chapters 5 and 6), and the long time frame includes recommendations for space agencies and technical infrastructure (chapters 7 to 11).

A second meeting was held in Perugia (September 2014) where terminology, timelines, consistency, cross-threading of chapters, case studies and additional authors was discussed. To date, two chapter drafts are completed, three are close to completion and the remainder are in various stages of progress. The WG has a fairly ambitious goal of having all chapter drafts completed by April 2015. The group will meet again in Geneva (April 2015) following the GEO water quality summit to review chapter content. The goal is to have a complete draft of the report by November 2015. The report will not be very technical in nature but will bring together data providers and users, and will outline challenges and show what can be achieved, referencing other IOCCG reports.

2.2 GEOHAB/IOCCG Harmful Algal Bloom Working Group

Stewart Bernard reported on the combined GEOHAB/IOCCG working group, which was a cross over between the ocean colour and HAB communities. The report outline includes an introduction to HABs in various ecosystems, bloom detection techniques, and a number of case studies as related to their impact. Other chapters include multi-sensor, multi-parameter integration for ecosystem observation as well as future perspectives and recommendations. The working group had processed a large amount of new data, which was very time consuming, but most of the material has been sorted out and the first draft of the report should be ready by April 2015.

Major issues for effective HAB application of ocean colour are poor atmospheric correction and algorithmic failures due to high optical complexity. Algorithms that bypass aerosol correction issues, e.g., FLH, can thus play an important role in high biomass and turbid waters. Narrow spectral bands from 620 – 750 nm are very important in this regard. The lack of a single product across a wide range of optical water types is a major impediment. More sophisticated PFT-type algorithms, e.g., size, offer valuable products, but generally only work successfully in systems of low ambiguity e.g., upwelling systems with low atmospheric complexity and very high algal biomass. Prior knowledge of ecosystem behaviour and typical bloom occurrence, and event scale information on potential bloom initiation/driving mechanisms is critical to realising the full value of ocean colour products.

2.3 Re-scoping the Coastal Water Algorithm Comparison Working Group

Vittorio Brando outlined his ideas for re-scoping the Coastal Water Algorithm Comparison (CWAC) working group, originally proposed by Kevin Ruddick to extend the round robin intercomparison of retrieval algorithms for coastal waters for the ESA CoastColour project. The initial group had not made much progress because it was difficult to assemble the required *in situ* benchmark dataset without a funded and dedicated program officer. Vittorio Brando and Suzanne Craig had agreed to try to revive the group.

Most working group members were not in favour of another algorithm intercomparison exercise unless it was a study of how the algorithms work. Inland waters and "extreme Case-2 waters" could perhaps be included in the scope of the WG, and also revisiting and updating IOCCG Report-3 (2000) on "Remote Sensing of Ocean Colour in Coastal and Other Optically-Complex Waters", as a guide for non-specialists. If there is a need for high quality dataset, the procedure and metrics for quality assurance must be specified. Many other related projects and working groups are already addressing similar issues and assembling *in situ* databases e.g., current IOCCG WGs, HIGHROC, INFORM, GLASS, Biodiversity 2, PACE science team, and the Limnades *in situ* dataset (GloboLakes). A new focus for the WG could be a study of how the algorithms work and what components of their form work best in which conditions e.g., define a set of metrics to determine the best algorithm for a given coastal/inland system. Also, rethink the paradigm for complex waters and evaluate ensemble approaches.

The committee agreed that there was a need to provide products that people can use and trust. It would be very useful to assemble a community database, although this is not feasible without a dedicated project officer. Stewart Bernard suggested that the WG could perhaps produce the technical underpinnings of breaking down the Case-1/2 water barrier. They could revisit parts of IOCCG Reports 3 and 5, and produce a comprehensive document on switching between

products, outlining why the various choices are made, leading up to a comment on ensemble/probabilistic approaches, perhaps with a "one-product-fits-all-water-types" concept? The multiple algorithm approach is a very powerful approach that can lead to more futuristic areas and is currently not addressed by existing projects. Ewa Kwiatkowska agreed that the working group should have a clear goal, perhaps to develop a blended product using different algorithms in different water types that could be implemented as a test evaluation product for ocean colour. Vittorio agreed to talk to the PIs at the Sentinel-3 meeting to discuss options and get consensus on the way forward. At the IOCCG Executive meeting following IOCCG-20, it was recommended that the WG should submit a new proposal integrating the ideas above, and specifically incorporating the multi-water algorithm concept, if there was sufficient interest by WG members. This would be reviewed at the IOCS meeting in June 2015.

ACTION 20/1: *If interested, Vittorio Brando and Susanne Craig to submit a proposal for a new IOCCG working group with the mandate of revisiting parts of IOCCG Reports 3 and 5, and specifically incorporating the multi-water algorithm concept (due date: 1 June 2015).*

2.4 Atmospheric Correction in Coastal Waters Working Group

Cédric Jamet summarized the goals of the IOCCG WG on "Atmospheric Correction over Turbid Waters" which aims to provide advice to end-users on the advantages and limitations of each algorithm and their performance under certain atmospheric and oceanic conditions. The WG is only focussing on algorithms that deal with non-zero NIR water-leaving radiances. A kick-off meeting was held in Wimereaux, France (15-15 May 2014) to refine the scope and methods for intercomparison, and another meeting took place before Ocean Optics (26 October, 2014). The group has had regular telephone conference calls to discuss development of the synthetic dataset and Radiative Transfer Model comparisons. The group will focus on MODIS-Aqua and then examine other sensors, if time permits, and will examine 12-14 different algorithms. They intend to implement all algorithms using same software (i.e., SeaDAS), if possible, with the help of Sean Bailey.

Match-up analyses will be carried out using i*n situ* measurements from group members along with the MERMAID dataset. Image analysis will also be carried out over selected areas, and classification of nLw as a function of IOPs will be done to see which type of algorithm performs best for each water type. A simulated dataset is required for sensitivity studies and will be distributed by July 2015, while the *in situ* datasets will be assembled and distributed by December 2015. It is anticipated that the analysis of results from the synthetic and *in situ* datasets will be completed by June 2016, while the analysis of satellite images will be completed by July 2016.

Bryan Franz suggested they also explore Rayleigh correction (without aerosols) to avoid limitations of the aerosols when doing NIR correction. For this reason, the group will also look at aerosol properties.

2.5 Ocean Colour Remote Sensing in Polar Seas Working Group

Simon Bélanger presented an overview of the new IOCCG report on "Ocean Colour Remote Sensing in Polar Seas" led by Marcel Babin, Kevin Arrigo and Simon Bélanger. The report has 6 chapters and includes general information on remote sensing in polar environments, specific algorithms for polar seas, estimates of net primary production from space (comparing 4 different algorithms), and recommendations. The group had assembled an *in situ* database to examine bio-optical properties and to carry out a sensitivity analysis to understand which of the non-phytoplankton components affects band ratio algorithms. Recommendations included extending atmospheric corrections over sun zenith angles greater than 70°, exploring other strategies to better correct for contamination by sea-ice, and designing new approaches to estimate contribution by under-ice phytoplankton blooms to new primary production. The report is currently being edited and formatted by Venetia Stuart and should be ready for publication by the end of the year.

2.6 Uncertainties in Ocean Colour Remote Sensing Working Group

Roland Doerffer submitted a draft, incomplete version of the uncertainties report so that IOCCG members might get an idea of the output of the working group. The planned working group meeting last year had to be cancelled due to time constraints of a number of members, but a meeting would be held in conjunction with the forthcoming IOCS conference in San Francisco (19 June 2015). Working group members are also participating in an IOCS splinter session on "Understanding and Estimating Uncertainty in Ocean Colour Remote Sensing Data and Derived Products".

2.7 Funding of Validation Activities

Following the Sentinel-3 validation team (S3VT) meeting in December 2014 there was some discussion on funding of validation activities. Rosalia Santoleri (CNR-ISAC) had drafted a community letter to the EC on behalf of the S3VT scientists, requesting that funding opportunities be considered for marine *in situ* bio-optical observations in the next Work Package of the Horizon 2020 Programme (2016-2017). IOCCG was also approached to co-sign the letter. The consensus was that IOCCG should endorse the letter by sending a separate

letter of support, outlining the bigger issues relevant to all agencies – i.e., a generic discussion on the importance of validation across all agencies and why validation should be built into all missions. Furthermore, it was agreed that this issue should also be raised at CEOS SIT, and brought to the attention of all agencies.

ACTION 20/2: *IOCCG to send an additional supporting letter to Philippe Brunet and Kurt Vandenberghe endorsing the letter sent by Rosalia Santoleri on behalf of the S3VT scientists (S. Bernard, V. Stuart).*

3.0 International Ocean Colour Science Meeting

3.1 PFT Splinter Workshop

Nick Hardman-Mountford reported on the IOCS follow-up workshop on PFTs which took place before Ocean Optics in Portland (October 2014). The workshop was attended by algorithm developers, *in situ* experts and agencies, and the main focus of the meeting was "Towards a validation strategy for PFT algorithms". Space agency requirements for PFT algorithm validation and intercomparison activities were discussed as well as validation activities for specific requirements (e.g., HABs, *Trichodesmium*). A full report of the workshop has been published in the NASA Technical Memorandum (TM) series, and is available on the IOCCG website. A key outcome of the meeting was several recommendations including establishing a number of validation sites that maintain measurements of a key set of variables, intercomparison of methods/instruments to understand capabilities to fully characterize the phytoplankton community, and organising workshops to address techniques for particle analysis, engaging with modellers to understand end-user requirements and establishing protocols for data storage and management. Initial user consultation provided product requirements to EUMETSAT for Copernicus planning. Another breakout session is planned for IOCS-2015 with a strong focus on user community engagement to move towards better defining product requirements. The group has also developed a comprehensive website (http://pft.ees.hokudai.ac.jp/satellite/index.shtml) as a community activity.

Stewart Bernard suggested that the group also focus on new technology such as Flow-CytoBot or holographic sensors to make more detailed measurements of the phytoplankton community. Paula Bontempi also noted that there were very few attempts at connecting physiology/cell counts and genus and species assessments in the ocean with radiometry. NASA recently funded a project to do an assessment of one cyanobacterial case study relationship with radiometry, but no datasets are available with cell counts and full spectral radiometry. The IOCCG PFT report will have to be revisited once we have hyperspectral data and automated *in situ* sensors. Stephanie Dutkiewicz mentioned the MAREDAT database (http://www.earth-syst-sci-

data.net/special_issue7.html) which has an ongoing compilation of *in situ* measurements of different PFTs that might be of interest to the PFT group.

3.2 In situ Protocols Workshop: Follow-on from IOCS-1 Splinter Session

David Antoine reported on the IOCS follow-up workshop on "In situ protocols" which also took place before the Ocean Optics meeting in Portland, led by Steve Ackleson. The workshop objectives were to plan and coordinate future work directed at updating protocols for measuring *in situ* and above water optical properties in support of ocean colour science. The group identified four topics to discuss (beam attenuation, volume scattering, in- and above-water radiometry) given that other protocol activities are either underway of planned. An expanded definition of protocols was adopted consisting of pre-deployment instrument preparation, best practices for instrument deployment, data reduction/quality assessment, and prescriptions for metadata and reporting. New community standards would be created through baseline information within the current protocols, journal articles, technical reports, and field experience accumulated over the past decade. In some cases, additional tests may be required to assess the accuracy of specific properties and associated parameters. Protocols will thus represent living documents with the understanding that future revisions may be necessary. An important element discussed was measurement uncertainty - the new protocols will aim to quantify the uncertainties involved in the various prescribed steps. The newly formed IOCCG "Protocol Coordination Activity" will be a valuable resource, serving as a clearinghouse of protocol information, including emerging opportunities for additional international support. The final draft of the beam attenuation protocols will be ready for community commentary by June 2015, volume scattering function by January 2016 and in- and above-water radiometry is currently underway. The group also plans to deal with protocols for floats.

3.3 Update of Plans for IOCS-2015 meeting

Venetia Stuart outlined plans for the upcoming IOCS meeting, scheduled to take place in San Francisco from 15-18 June 2015. The format of the meeting would include seven keynote speakers, eleven space agency presentations on the status of existing and planned missions, ten breakout sessions (three parallel sessions), the NASA OCRT meeting, a panel discussion, two poster sessions to review the progress of ocean colour research and a session entitled "Visions & Hallucinations" - very short talks outlining highly innovative or provocative concepts in ocean colour science. Breakout sessions had already been selected and registration for the meeting was progressing well. The IOCCG had also received an offer from EUMETSAT to host the third

IOCS meeting in Europe, early May, 2017. This offer has been gratefully accepted. There was also consensus that Craig Donlon (ESA) should be invited to chair a panel discussion at IOCS.

ACTION 20/3: *Send invitation letter to Craig Donlon inviting him to chair a panel discussion at IOCS-2015 (S. Bernard, V. Stuart).*

4.0 Agency Reports on New/Emerging Initiatives

4.1 NOAA Ocean Colour Activities

Paul DiGiacomo provided an update on NOAA ocean-colour activities, specifically VIIRS end-to-end data processing and Cal/Val (led by M. Wang), distribution of VIIRS ocean colour data/products via the NOAA CoastWatch Program (led by P. DiGiacomo) and NOAA users & applications. VIIRS ocean colour products have been improved after the implementation of important updates, new algorithms, and with vicarious calibrations. MOBY *in situ* optics data have been providing critical data in support of VIIRS calibration and validation activities and MOBY is currently undergoing a "refresh" of the system. A dedicated international, multi-agency VIIRS Cal/Val cruise took place in November 2014, which could be seen as a contribution to INSITU-OCR and should hopefully be an annual occurrence. Although there are still some issues, evaluation results indicate that VIIRS-SNPP is capable of providing high-quality global ocean colour products in support of science research and operational applications. NOAA is preparing for reprocessing the entire VIIRS mission ocean colour data set within a couple months. NOAA/NESDIS/STAR plans to provide NRT access to global OLCI and SLSTR data products from EUMETSAT - an agreement between the United States and European Commission is in the works.

4.2 NASA Update on Future Missions and Research Planning

Bryan Franz provided an update on the MODIS, VIIRS and HICO sensors. The HICO mission was officially terminated in late December but the data were very useful for development of PACE algorithms. NASA is currently undergoing a full reprocessing of all global missions to ensure continuity of the long term data record. VIIRS and OCTS dada have been processed while MODIS-Aqua and Terra, SeaWiFS, and CZCS are in progress. MODIS instruments on Terra and Aqua continue to operate with no major anomalies, although MODIS-Aqua has shown increased temporal variability in blue (412, 443) water-leaving reflectance trends since 2011, and a shift in all radiometry in 2014 as a result of calibration error. OBPG and MCST are working to resolve these issues in preparation for reprocessing in the coming months, but progress has been limited - both MODIS instruments are simply getting old. NASA is currently

producing and distributing standard VIIRS ocean colour products and they have made significant progress in resolving calibration issues and reducing image striping artifacts. There is improved agreement of VIIRS with MODIS-Aqua, and historical norms after the R2014.0 reprocessing.

Paula Bontempi presented the PACE Mission which will carry an ocean colour instrument and potentially a polarimeter. The primary objective of the mission is to understand and quantify global ocean biogeochemical cycling and ecosystem function in response to environmental variability, with a secondary objective of quantifying the role of aerosols and clouds in physical climate. Launch is planned for 2022/2023 and is budget and profile driven (an iterative approach to maximize capabilities within the cost cap). The mission will address seven major science questions covering management as well as ocean colour research. Several calls for vicarious Cal/Val of the mission will be issued jointly by OBB and Earth Science Tech Office (ESTO) through ROSES, along with competitions for the science team. The current science team is led by Emmanuel Boss and will produce a consensus report on operational algorithms for atmospheric correction and IOPs. Several field campaigns have been established to accompany satellite missions, including the ICESCAPE program (impacts of climate on ecosystems and chemistry of the Arctic Pacific), EXPORTS (ocean's biological pump), Arctic COLORS (coastal and land interactions in the Arctic) and ICESOCC (southern ocean carbon cycle).

4.3 CNES: Ocean Colour Developments

Juliette Lambin reported on CNES's ocean observation program. Ocean sciences are of major interest to CNES's Earth observation program and a strong scientific community is supported through dedicated research funding as well as several larger scope projects such as Bio-Argo and BOUSSOLE. The Parasol/POLDER mission was not dedicated to the ocean but has ocean products which are produced on demand. The data are currently being reprocessed and the products may be placed online, depending on demand. The proposed OCAPI mission plans to address ocean colour from a geostationary orbit. Scientific objectives include measuring diurnal cycles of ecosystems with quasi-daily cloud free coverage (1-h revisit, geostationary orbit, 250 m resolution and 16-18 spectral bands). The OCAPI proposal was not selected despite an excellent science review because of cost issues as well as technical problems. Nevertheless the science program committee has confirmed that it is the main "short term" priority for CNES's Earth Observation program and a decision was made to proceed to Phase A in 2015 with the objective of preparing a proposal for EE9 and fostering European support to help reduce costs.

4.4 JAXA: GCOM-C/SGLI New Developments

Hiroshi Murakami reported on new developments with the GCOM-C1/ SGLI mission (250 m spatial resolution in the visible and NIR). Pre-launch tests of the SGLI pre-flight model are ongoing - the sensors will be integrated to the satellite system stating in April 2015, with a scheduled launch in 2016.

Regarding algorithm development, the mission is currently in launch preparation phase (JFY 2013-2015). The next announcement for research opportunities will be in summer 2015. Detailed planning of post-launch *in situ* measurements for Cal/Val is also underway with routine observations around Japan as well as plans for offshore campaigns and international collaboration. Regarding data distribution, all standard products (L1, L2, L3) will be distributed via the internet. Data will be released to the public one year after launch and will be free for both science and commercial purposes. It is likely that both L1A and L1B data will be distributed.

4.5 ESA: Update on Sentinel-3 Development

Peter Regner gave an update on the status on the multi-instrument Sentinel-3A mission. The OLCI ProtoFlight model has been fully characterised and integrated on the satellite and the qualification and acceptance review will take place in July 2015. A request has been sent to Eurockot to change the launch period to Oct - Dec 2015, with a preliminary launch slot in October 2015, which will be confirmed by the end of March 2015. Several important milestones must be successful before the satellite can be launched into orbit from Plesetsk in Northern Russia on a Rockot launcher. Regarding Sentinel-3B, the final acceptance review is predicted for Q1 2017, with the earliest launch date at the end of Q2 2017, depending on the availability of launch windows. The ITT process for placement of procurement contracts for the C and D units of the S-3 satellite are expected to be completed by the first half of 2015.

All Sentinel-3 Core Ground Segment facilities are established, and on-site qualification and acceptance activities are scheduled for April to July 2015. EU-ESA and EU-EUMETSAT agreements have been signed, providing full coverage for Sentinel-3 mission operating costs.

The Sentinel-3 Cal/Val plan has been endorsed - there will be limited L0/L1 data available for Cal/Val. Sentinel data access is governed by the Copernicus Data and Information Access Policy. There will be free and open access to Sentinel data during the Copernicus operational phase including a rolling archive for Sentinel core products, access for Copernicus services (including EUMETCAST), and a collaborative ground segment with mirror sites managed by third parties.

A first release of the Sentinel Scientific Toolbox called SNAP (SentiNel Application Platform), supporting users in the exploitation of data products of the Copernicus Sentinel satellites, is available for free download from the Web. There are plans to develop toolbox functions facilitating entry into cloud processing services, so that users will not have to download large volumes of Sentinel data, just the resulting output products. As part of ESA's Scientific Exploitation of Operational Mission (SEOM) program, three proposals have been funded for evaluating new approaches for: 1) Integrated PAR; 2) Extreme Case-2 Waters (to tackle difficulties such as high sediment load and high scattering); and 3) Carbon Pools in the Ocean.

4.6 EUMETSAT Ocean Colour Services

Ewa Kwiatkowska reviewed ocean colour activities at EUMETSAT, including operations of the marine center and S3 platform and instruments, and redistribution of 3rd party data (e.g., VIIRS data). The Sentinel-3 Mission Performance Framework includes joint ESA/EUMETSAT quality working groups and a joint S3-Validation Team. A successful S3VT meeting was held in December 2014 with sessions dedicated to determining requirements to ensure the best quality *in situ* measurements for ocean colour Cal/Val (i.e., fiducial reference measurements). There will be three ways to access data and products from EUMETSAT including EUMETCast (satellite and terrestrial, the main method of disseminating data in NRT), online data access (rolling archive of one month) and EUMETSAT data centre (complete historical archive). The Sentinel-3 data package will consist of a folder holding a collection of XML and binary files (NetCDF). EUMETSAT plans to reprocess the data, but the reprocessing will only be available from the data center. If users are interested to receive data early in the mission they should subscribe to EUMETCast. Authorised users and S3-Validation Team members will start receiving data for Cal/Val approximately 2 months into the mission. Level-3 products are not assumed to be official products from the mission, and will likely be a part of the marine services.

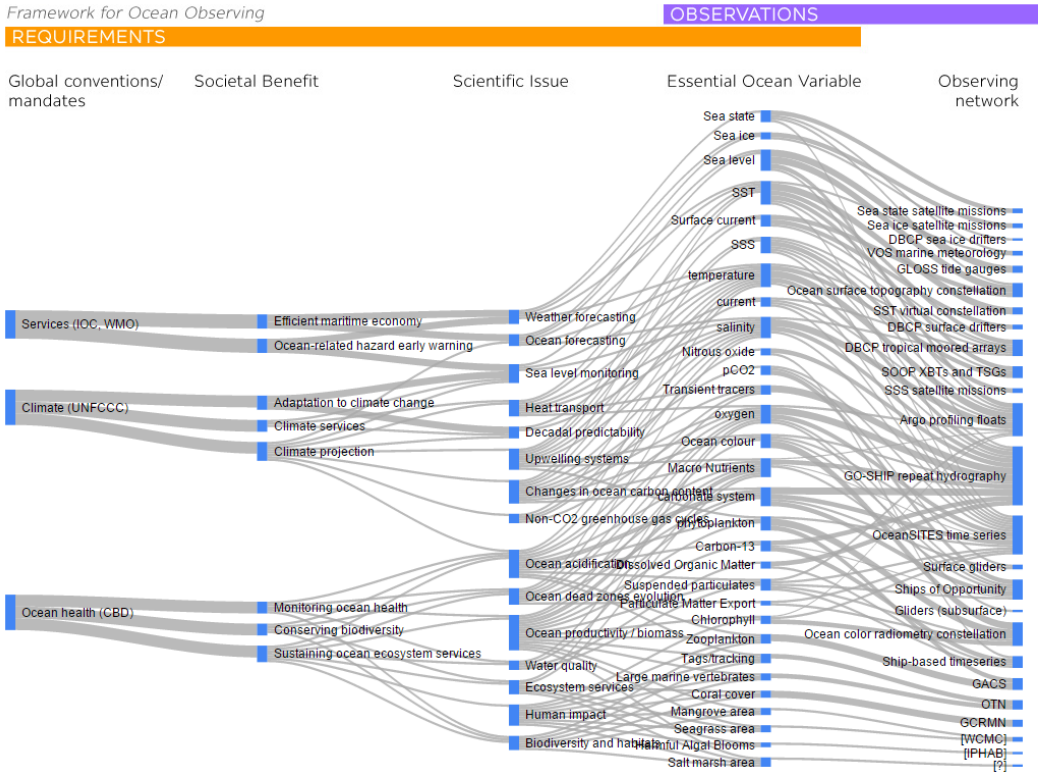
4.7 Discussion: Distribution of Level-1A data for Sentinel-3

Stewart Bernard updated the committee about the discussions held in the Executive meeting. The main issue is that if Level-1A data are not distributed, the agencies must re-download entire data set for reprocessing. The IOCCG would like to advocate for a Level-1A product, but there are political and cost implications. A letter will be sent to Philippe Brunet on behalf of the ocean colour scientific user community, requesting that a Level-1A data product be considered. As a parallel effort, the dissemination of L1A data in a multilateral context will be presented at the next SIT meeting, to be delivered to CEOS Plenary.

5.0 Synergies with other Programmes

5.1 The Global Ocean Observing System (GOOS)

Albert Fischer presented the framework of the Global Ocean Observing System (GOOS), a collaborative system of sustained observations, driven by requirements. He presented the graphic below for the framework for ocean observing (http://lists-ioc-goos.org/goos-strategic-mapping-graphic/), visualizing the connections between the three global mandates (services, climate and ocean health) and societal benefits, scientific issues, essential ocean variables (EOV) and observing networks. It is not possible to measure all EOVs, but rather identify what is essential, and focus on measurements that are feasible and have a high impact. Ocean colour is listed as an essential ocean variables and the OCR-VC is seen as an ocean observing network.



GOOS is a collaborative framework working through three observing system panels i) Physics and Climate (OOPC) panel, ii) Biogeochemistry panel, and iii) Biology/Ecosystems panel. These panels interact with the GOOS Steering Committee and the Technical Advisory Groups. There are opportunities for collaboration – IOCCG is seen as an ocean observing element of GOOS and in some sense also an innovator, through development of new products. Ocean colour and its products fall at edge of the GOOS biogeochemical and biological panels. Paula Bontempi pointed out that there were several items on the list that can be estimated using ocean colour

e.g., CDOM, and Paul DiGiacomo noted that the descriptions of the satellite observation networks might not be fully correct. The IOCCG was welcome to take the graphic and reports from the GOOS panel and provide some clarity.

Action 20/4: *OCR-VC to provide a redaction of where IOCCG fits into GOOS and also to correct their description of the framework for ocean observing (P. DiGiacomo, S. Bernard)*

5.2 GODAE Ocean View Marine Ecosystem and Prediction Task Team

Marion Gehlen presented the GODAE Ocean View (GOV) Marine Ecosystem and Prediction Task Team (MEAP-TT), which was established as an outcome of the first IMBER-GODAE working group in 2007. The focus of MEAP TT is to develop the underpinning science and tools to enable full integration of biogeochemistry and ecosystems to existing physical operational systems, by improving and developing assimilation schemes for biogeochemical observations, modelling Essential Biogeochemical Variables (EBV) and bridging the gap with end-users. A variety of assimilation schemes are being used and, in future, physical and biochemical data should be assimilated together. Ocean colour products are used for applications in operational oceanography and biogeochemical research. There is a tendency for models to go to higher spatial resolution which raises the demand on ocean colour data. Currently ocean colour products can be used to constrain coupled physical/biochemical models but the temporal and spatial coverage is too low for assimilation into eddy-resolving models (the current capability is global biological state at $1/4^{o}$, weekly updates). Methods are being explored for synergistic use of HRES satellite observations (e.g., ocean colour combined with altimetry) to refine horizontal circulation estimates. Ocean colour products are also used in process studies e.g., to detect trends in response to climate change or to examine the diversity of the surface ocean ecosystem (change of PFTs, phenology etc.). This requires continuous observation records as well as further development and improvement of algorithms for PFT identification, suspended particle and size spectra and Chlorophyll:Carbon ratio. Problems include under-sampling of key regions (cloud cover) and poorly constrained uncertainty. Continuity in space and time is also essential (no gaps in missions). The GOV MEAP-TT workshop will be held in Halifax, Canada (23-24 June 2015) and it would be helpful if a representative of the ocean colour modelling community attends the workshop. Stephanie Dutkiewicz agreed to attend.

Action 20/5: *Stephanie Dutkiewicz to attend the GOV MEAP-TT workshop in Halifax to represent the ocean colour modelling community.*

The Committee agreed that it was important to know how the numerical modelling community uses ocean colour data, which products are used, and what are the requirements. Combining

ocean colour data in models can be used to “fill in” gaps in space and time for missing data. There was consensus that a working group should be formed on numerical modelling of ocean colour data - Stephanie Dutkiewicz agreed to Chair such a working group. Potential members could include Marion Gehlen, Katja Fennel, an IPCC representative, a representative from the assimilation community (e.g., Watson Gregg or Ceclie Rousseaux), Stephanie Henson, Emlyn Jones from CSIRO, Rick Gould from the Naval Research Laboratory and a representative from the UK MET Office. It was also suggested that the proposed WG engage with the "Marine Ecosystem Model Intercomparison Project" (MAREMIP) working on the development of models based on PFTs.

Action 20/6: *Stephanie Dutkiewicz to prepare a proposal and draft Terms of Reference for a new IOCCG working group on “Ocean Colour Applications for Biogeochemical and Climate Modelling” by June 2015.*

5.3 Discussion: Pursuing an Operational Biogeochemical Component of OCR-VC

Stewart Bernard presented a few key points regarding the development of a proposed combined dataset with merged GHRSST-type products applicable to all water types. This is difficult to do and we are not ready yet, but it would be very useful to have products that are suitable for use across Case-1/Case-2 waters (a major barrier to the uptake of ocean colour data). There was agreement that a product of this type would be very useful, and could perhaps be a demonstration product associated with Sentinel-3, representing EUMETSATs contribution to INSITU-OCR. Ewa Kwiatkowska agreed to investigate development of a Sentinel-3 multi-water demonstration product at EUMETSAT.

Action 20/7: *EUMETSAT to investigate development of a Sentinel-3 multi-water demonstration product (E. Kwiatkowska).*

6.0 Building the Operational Component of INSITU-OCR

6.1 Progress with implementation of CEOS OCR-VC

Paula Bontempi presented OCR-VC progress towards established CEOS-GEO priorities. Several actions from the SIT-29 meeting need to be considered. The CEOS Strategy for Carbon observations from Space has been finalized but it does not contain a lot of material regarding aquatic or ocean carbon, so this issue would be raised at the next SIT meeting. CEOS would like agencies to update lists of datasets currently available from historical and current

polar/geostationary ocean colour satellites. Several links are available on the IOCCG website at www.ioccg.org/data/sensors.html.

Action 20/8: *IOCCG Agencies to provide new links to publically available ocean colour data sets, or update the links currently available on the IOCCG website (Venetia Stuart to coordinate).*

CEOS would also like all agencies to update the list listing of current (ioccg.org/sensors/current.html) and planned (ioccg.org/sensors/scheduled.html) ocean colour sensors on the IOCCG website. All

Action 20/9: *All IOCCG agencies to provide information to Venetia Stuart to update the timelines and specifications for the current and planned lists of ocean colour sensors on the IOCCG website. P. Bontempi, P. Regner and P. DiGiacomo to provide information to CEOS.*

Regarding the catalog of Cal/Val infrastructure and activities, the results of the mapping exercise would be used. Ocean colour will play a critical role in all six components of the GEO Blue Planet tasks. OCR-VC members serve in active leadership roles for several of the components and will broadly contribute to the Blue Planet Symposium to be held in Cairns, Australia in May 2015. A virtual constellation/working group day will be held back-to-back to the CEOS Technical workshop on 15-17 September in Darmstadt (SIT-31). An OCR-VC representative was required for the SIT-30 meeting in Paris (31 March – 1 April 2015) – IOCCG agreed to sponsor Paul DiGiacomo to attend the meeting.

Action 20/10: *Paul DiGiacomo to attend the SIT-30 meeting in Paris (31 March – 1 April 2015)*

6.2 Task Force on ECV Assessment

Jim Yoder provided an update on the OCR Essential Climate Variable (ECV) Task Team. He introduced a book edited by G. Zibordi et al. entitled "Optical Radiometry for Ocean Climate Measurements", which lays out many important aspects of ECVs. The task team was charged with determining how to produce basin to global scale ECV/CDR time series of ocean colour products (specifically Lw and derived products) for climate-related studies. Excellent progress had been made by all groups with representatives on the Task Team including NASA OBPG, GlobColour, JAXA, GlobCoast project, CCI Project, MEaSUREs, Phenology and Other Applications and NOAA. A characteristic of all of the projects is the emphasis on understanding bias and other uncertainties, and how to determine quantitative measures of both. Various group were also finding common patterns i.e., radiometry expressed as Chlorophyll is declining in the ocean basins. The various groups have not yet directly compared the time series they are generating,

but it would be interesting to compare ECV products between the different groups. It was also important to identify new co-chairs for the group, preferably someone involved with one of the efforts to produce OCR ECVs. Bryan Franz and David Antoine were suggested as possible candidates – this would be discussed offline.

Action 20/11: *Confirm new co-chairs of ECV Task Force (B. Franz, D. Antoine).*

There was also a request to have Jim Yoder's presentation made available on the IOCCG ECV Task Force webpage.

Action 20/12: *Jim Yoder's ECV presentation to be included on IOCCG website (V. Stuart).*

6.3 Inter-Agency Task Force on Satellite Sensor Calibration

Ewa Kwiatkowska provided an update on the inter-agency calibration task force on satellite sensor calibration, which was established following a recommendation from the INSITU-OCR White Paper. The goal of the task force is to create a framework for collaboration among instrument calibration experts from agencies engaged in the OCR-VC initiative, and will focus on calibration needs specific to ocean-colour measurements. It is a joint IOCCG and CEOS OCR-VC activity and is also recognized by CEOS WGCV IVOS. The task force will focus on instrument calibration and characterization (pre-launch and on-orbit) but will not address system vicarious calibration. The task force has a long term structure and its Terms of Reference will be supplemented by an annual program of work. A webpage has been established for the group on the IOCCG website. A dedicated splinter session will take place during the 2015-IOCS meeting and the task force will also work closely with, and participate in, other related meetings (e.g., S3VT, CEOS WGCV IVOS). The task force is co-chaired by Ewa Kwiatkowska (EUMETSAT), Gerhard Meister (NASA GSFC) and Bertrand Fougnie (CNES). It was noted that the CGMS group (Coordination Group for Meteorological Satellites) was also interested in Cal/Val of ocean colour sensors and data dissemination, so the task force will work closely with them in the future.

6.4 Way forward with implementation of INSITU-OCR, including mapping exercise, community AOP/IOP processor

Stewart Bernard reported on progress with INSITU-OCR implementation. There are four key recommendations the group intends to take forward to provide multi-agency support for ocean colour data quality: sensor calibration/characterization, development & assessment of satellite products, *in situ* data generation & handling, and information management & support. During

the recent "mapping exercise" agencies were requested to give feedback on "new inter-agency activities" and "in-kind contributions based on existing activities".

In order to move forward with a simple implementation plan, the Chair suggested focussing on two items: new multi-agency capabilities, and *in situ* data generation and handling. The latter was broken down into 8 actions in the mapping exercise, 5 of which could be addressed with an AOP/IOP community processor for *in situ* data, if done in a comprehensive manner (e.g., improving traceability of *in situ* measurements, uncertainty budgets, quality assurance and archival of *in situ* data). This was a very ambitious approach although there were many advantages i.e., a common data format, common processing schemes etc. A "lightweight" common processing scheme (e.g., common library code) would not provide the same kind of power in terms of traceability and archiving, and the benefits would not be as comprehensive. An ambitious AOP/IOP Community Processor could provide an end-to-end processing and archiving system requiring substantial resources for scoping, development and dedicated ongoing operations. Benefits would include traceability, uncertainty estimates, QA, archiving and substantial improvement in data quality and utility, with little overhead for the community.

A key issue is to try to establish a modular system which would allow for investment from agencies according to their own interests, through in-kind contribution to an INSITU-OCR Project Office. Paula Bontempi agreed that this was the nature of what needs to be discussed to implement INSITU-OCR and to increase the quality of *in situ* data without too much investment. Giuseppe Zibordi noted that the advantage of moving towards a community standardised processor was that the protocols and processing methods are known, so if there is a change in protocols, the data could be easily reprocessed. It might be difficult to implement, but overall it would be a very useful and positive step. Paul DiGiacomo suggested that a small group be established to draft requirements, then agencies would be in a position to help fund various activities. Stewart Bernard offered to do this, with help from Giuseppe Zibordi. First, the main structure of the system would have to be developed, then researchers involved with protocol development could be approached for specifications on data processing for individual components. Ideally one company should take over the design of the infrastructure and a common language should be agreed upon to ensure homogeneity.

ACTION 20/13: *Stewart Bernard and Giuseppe Zibordi to draft requirements for a community AOP/IOP processor for in situ data.*

There was also some discussion about the role of a potential Project Officer for INSITU-OCR, although the Chair suggested that this could be addressed at a later stage.

6.5 NASA contributions to INSITU- OCR: in situ protocols coordination and vicarious calibration

Paula Bontempi reported on the proposed IOCCG Protocol Coordination activity - a pilot project for INSITU-OCR implementation. A small committee is being established of individuals with access to information about institutional activities and funding opportunities (not necessarily protocol practitioners) with the aim of cataloging information related to *in situ* measurement protocols. An IOCCG website would provide a clearing house for protocol information. The group plans to hold regular telephone conference calls each year to discuss progress, coordinate participants, and identify new events and funding opportunities. The goal is to reduce redundancies in efforts, collaboratively fill gaps, and target new opportunities to move the community forward. Current points of contact for questions and comments are Jeremy Werdell and Paula Bontempi.

As a pilot investment to take INSITU-OCR forward, NASA has released a vicarious calibration instrumentation competition related to the PACE mission, through ROSES FY2014. The current requirement for calibration uncertainty of ocean colour sensors is <0.5% (with target value of 0.3%) in the blue-green spectral regions for oligotrophic/mesotrophic waters. Three projects were selected (US$10M over 3 years): i) Andrew Barnard (Western Environmental Technology Laboratories) - to incorporate a new hyperspectral radiometer onto autonomous profiling floats for accurate measurements of water-leaving radiance for satellite vicarious calibrations, ii) Carlos Del Castillo (Goddard Space Flight Center) - to investigate the suitability of a wave glider as a platform to support offshore radiometry measurements (called HARPOONS), and iii) Kenneth Voss (University Of Miami) to develop a small MOBY-NET instrument, suitable for development a network of these instruments operated by local collaborators, to be used for vicarious calibration of ocean colour satellites.

6.6 ESA: Traceability of OCR validation: towards a Fiducial Reference Measurements network

Bojan Bojkov, Head of Sensor Performance, Products and Algorithms at ESA, informed the committee about ESA's investment to take the OCR-VC forward - an open invitation to tender (ITT) addressing the need for improved *in situ* instrumentation and community consensus protocols for instrument calibration and vicarious adjustments, as well as establishing traceability to metrological institutes. The project, termed QA4EO/FRM4SOC, to be released in Q2/2015 (budget 500K € for 24 months), will establish and maintain SI traceability of Fiducial Reference Measurements (FRM) for satellite ocean colour through the development,

implementation and reporting of instrument laboratory and field inter-comparison experiments, supporting measurements, protocols, and dedicated international coordination activities. The group will also investigate the way forward for the next generation of European ocean colour vicarious calibration/verification infrastructure (complimentary to the NASA PACE activity). The participation of National Metrology Institution (NMI) is mandatory to achieve credible (and traceable) success in this project. The group was trying their best to implement all the recommendations from the INSITU-OCR White Paper.

In the ensuing discussion, committee members noted there were two independent plans for the way forward (NASA and ESA) and queried whether the agencies could work together to integrate and coordinate, e.g., develop requirements together (e.g., IOCCG Report 13) or each agency to fund a certain component. Stewart Bernard noted that a way forward could be for the Europeans to resource some component of the proposed community processor (item 6.4) – there could be a shared responsibility to deliver as well as use the processor. Bojan Bojkov noted that they were open to suggestions from ESA's side, but they must have clear terms of reference.

7.0 Agency Updates on New/ Emerging Initiatives (contd.)

7.1 CSA NetColor Initiative

Simon Bélanger presented the Canadian Network on Coastal, Oceans and Lakes Optics Remote Sensing (NetCOLOR), representing the ocean colour community in Canada (academia and government), and funded by the Canadian Space Agency (CSA). The first meeting took place in September 2014 in Quebec City, where the goals and long-and short-term objectives of the group were refined. The aim of the network is four-fold: i) to facilitate scientists to get together and develop common research projects, ii) to identify potential Canadian users and convey their needs to relevant agencies, iii) to provide a common voice to convey requirements to CSA, and iv) to facilitate access to publically funded *in situ* data for development of algorithms. The key science sectors identified include using ocean colour radiometry to monitor "optical" water quality in lakes, rivers and coastal environments, monitoring bio-optical properties in the Arctic Ocean, and studying biogeochemical cycles on various scales (local to global). Actions resulting from the meeting included hiring a research assistant to standardise Canadian *in situ* data sets and make them available in SeaBASS, organise an annual science meeting (October 2015), communicate with CSA regarding requirements for the hyperspectral WATERSAT mission and prepare a report on the status and vision of water colour remote sensing in Canada.

The WATERSAT mission is currently in Phase 0 (feasibility study) - the "User Requirements Document" was recently reviewed by members of the NetCOLOR Steering Committee. Any

decision to proceed to a Project/Mission phase will be required to go through a new Space Governance approval process. The mission is an inland oriented mission focussed on Canada. Andrew Tyler pointed out that the Limnades database would be launched soon and could be very helpful for the group.

7.2 INPE/CONAE: Argentine-Brazilian SABIA-Mar Mission

Daniel Caruso (CONAE) submitted a presentation on the SABIA-Mar mission, a joint effort between CONAE and INPE. The mission will consist of two satellites flying as a constellation. Each agency has some shared responsibilities while the Operations Control Center is under AEB (Brazil) responsibility and the Mission Center under CONAE responsibility. There are two mission scenarios: global and coastal, the latter of which could be increased depending on resource availability. The primary mission objective is ocean colour (200m, 1 d revisit for coastal and 800 m, 1 d revisit for global) with SST as a secondary objective (400m, 1 d revisit for both scenarios). The primary instruments are a UV-VIS Camera (11 bands, 1350 km, 200/800m) and a NIR-SWIR Camera (6 bands, 1350 km, 400/800m). Launch is scheduled for early and late 2019 for the two satellites. Stewart Bernard pointed out that if the 710 band was present, they should also consider bands at 885 and 900 nm to correct for water vapour absorption (but they may have an alternative plan).

7.3 KIOST Update on GOCI-I and II Missions

Youngje Park submitted an update on the Korean GOCI-I & II missions. GOCI-I calibration status displayed a small (<1%) degradation for all bands indicating that the sensor is in a very stable state. The GOCI Data Processing Software (GDPS) has been updated with improvements to the atmospheric correction and improved products. One of goals of mission is early detection of coastal disasters – GOCI was used to identify the spatial coverage of a massive harmful algal bloom in September 2014, and large patches of *Sargassum* in January 2015. The GOCI-II instrument will have higher specifications than GOCI, with more bands (12 VIS/NIR + 1 wide band), higher spatial resolution 250 m (local area mode) and an observation interval of 10 times/day, with full disk coverage (1 km) once per day. The goal is to develop an "Integrated Data Processing System" for GOCI-II to complete the whole process from satellite data reception, to correction, processing and distribution within 1 hour. The mission is currently in detailed design phase and should be launched in early 2019.

David Antoine noted that the GOCI sensor was built by Astrium in France, so the proposed French OCAPI mission could also benefit from this technology. Bryan Franz informed the committee that NASA Goddard had a data exchange with KIOST, and they had the entire GOCI data set in house and were now waiting for permission from the Korean ministry for data

redistribution. It was a very valuable data set for learning about the limitations of atmospheric correction angles etc. A smaller dataset was also available in France for development of applications. The group has been very collaborative so the IOCCG committee suggested that a letter be sent to KIOST/KARI expressing appreciation for GOCI data and for the rapid development of the GOCI and GOCI-II missions.

Action 20/14: *IOCCG to send a letter to KIOST/KARI expressing appreciation for GOCI data and for the rapid development of the missions (D. Antoine, S. Bernard, V. Stuart).*

7.4 ISRO Update on OCM-2/3

Prakash Chauhan reported on ocean colour applications in India, via Skype, and also provided an update on the Oceansat-3 mission. India has an extensive EO program - the Oceansat missions provide continuity of ocean colour data in India for potential fishing zone (PFZ) services through INCOIS. The Oceansat-3 mission, carrying a 13 band Ocean Colour Monitor (OCM) will be launched in 2018. In addition, the experimental geostationary GISAT mission carrying high resolution and hyperspectral payloads to cover Indian land masses, will be launched around 2017. A wide range of ocean colour activities are being carried out in India including algorithm development, Cal/Val, carbon fluxes, development of *in situ* data bases, fish stock assessment using primary production, spatio-temporal phytoplankton variability in the Indian Ocean etc. The OCM payload on Oceansat-2 is working nominally and has provided five years of ocean colour data around India. ISRO is working with PML to re-analyse OCM derived water leaving reflectances, which has significantly improved global OCM data products. An extensive *in situ* sampling programme is also underway in partnership with large marine institutes in India e.g., INCOIS, NIO.

The Oceansat-3 OCM instrument is far superior to Oceansat-2, with 13 spectral bands including a new channel at 556 nm for *Trichdesmium* detection, a fluorescence triplet (670, 681 and 710nm) and an additional channel in the SWIR (1010 nm) for atmospheric correction over coastal waters. Local Area Coverage is at 360m and Global Area coverage at 1 km, with complete global coverage in 2 days. The launch is scheduled for 2018. GAC data products including geophysical products from Oceansat-2 OCM are being disseminated by www.nrsc.gov.in and LAC data and geophysical products are available from NRSC Data Centre in Hyderabad. Ewa Kwiatkowska enquired whether the data set from the Kavaratti buoy could be made available for global vicarious calibration – some data was available through the INCOIS website, but if specific data was required Prakash could follow up.

7.5 Highlights of Chinese Ocean Colour Missions

Zhihua Mao presented some highlights from the series of Chinese ocean colour missions. The HY-1A (2002) and HY-1B (2007) missions, carrying the COCTS and CZI ocean colour sensors, are still in operation. Accuracy is a problem with HY-1B because there is no on-board calibration system (the cross-calibration technique is applied for data processing). HY-1C and D will be launched in 2016/2017 (still no on-board calibration system).

The HY-2A mission was launched in 2011, carrying three payloads (scatterometer, altimeter and radiometer) while the FY-3 series was launched in 2008 (FY-3A), 2010 (FY-3B) and 2013 (FY-3C). There is also the HJ series of environmental satellites: HJ-1A and B (2008) and HJ-1C (2012), carrying a CCD camera (4-bands, 30 m resolution) an infrared multi-spectral camera (4-bands, 150 m resolution) and a hyperspectral imager (110 – 128 bands, 100 m resolution, low S/N). A new atmospheric correction approach (ENLF) was developed for coastal turbid waters, which works very well.

7.6 GloboLakes

Andrew Tyler provided an update on the GloboLakes project, a collaboration between six UK institutions to investigate the global status of lakes and their responses to environmental change. The key question that GloboLakes seeks to address is what controls the differential sensitivity of lakes to environmental change. The group is building a satellite-based observatory with an archive and near real-time (NRT) data processing for more than 1000 lakes globally, exploiting data from multiple sensors (SeaWiFS, MODIS, MERIS + (A)ATSR, Sentinel-3 OLCI + SLSTR) to produce a time-series of up to 20 years for large lakes. The data will be freely distributed to end-users via web portal and ftp. The project is structured around 8 work packages focussed on the development & validation of EO algorithms, data uncertainties, data analysis & interpretation, and end user applications.

The Limnades database (to be launched in April/May 2015) currently holds data from 20 contributors from ~1200 lakes in 12 countries, with reflectance data from ~2500 stations (>650 stations with i*n situ* IOPs). The data cover 5 orders of magnitude variation in Chlorophyll-a, 4 orders in TSM and 3 orders in CDOM, and is being used to test and validate various algorithms. Some algorithms perform well but only over select ranges of chlorophyll. Several clustering techniques were applied to the reflectance spectra to identify waters with discrete optical properties, and algorithms were tested within each cluster to see over which dynamic range a particular algorithm performs well. The best performing algorithms are being implemented in a

processing chain at the Plymouth Marine Laboratory. A processing chain called caLimnos is also being developed to operationalise data production, starting in August 2015.

8.0 Capacity Building

8.1 Report of Second IOCCG Summer Lecture Series

David Antoine provided a brief update of the two-week long 2014 Summer Lecture Series (SLS) in Villefranche. A total of 24 students from 13 different countries were selected from a record number of applications (142). IOCCG covered about one third of the budget with additional support being obtained from OCB, SCOR and CNES with strong support by local French organisations, i.e., the Laboratoire d'Océanographie de Villefranche (LOV), the Villefranche Observatory (OOV) and GIS COOC (Groupement d'Intérêt Scientifique - COlour of the OCean). The course consisted of lectures given by 13 prominent scientists as well as several practical sessions, although the goal was to have more lectures than practical sessions to avoid replicating the course organised by the University of Maine, and to provide more theoretical aspects. The feedback from the course was excellent – all the lectures were video recorded and are available on the IOCCG website (they have been downloaded thousands of times). The plan was to hold another SLS in July 2016. Heidi Dierssen noted that it was very expensive to have such a large number of teachers and suggested than an on-line course might be more beneficial and would reach a larger number of students.

8.2 Discussion: Integrated IOCCG Approach to Capacity Building

Stewart Bernard noted that there were not enough training opportunities because of the high demand for the SLS. A more integrated approach to advanced training was required, as well as additional regional training courses, and perhaps a training workshop focussed on more complex waters. Several organisations conduct regional training courses e.g., POSRCEC, Dragon, NOWPAP, Darling Cornell, JRC Africa, POGO etc. – perhaps IOCCG could provide a resource listing all upcoming training courses and provide documentation to help people decide which course to apply for. Heidi Dierssen suggested that the IOCCG consider funding the development of a dynamic interactive online course on basic ocean optics, with graded assignments and interactive forums. IOCCG members agreed that online courses have a great deal of value and could complement current IOCCG training efforts e.g., students would have to complete the online course before being eligible to apply for regional workshops or the SLS. Ewa Kwiatkowska also noted that EUMETSAT had a strong user services department, organising practical courses in Africa on data utilization and downloading resources. They are currently

hiring a trainer for the Copernicus Program with additional resources coming in online. She would consult with them to see how they can support IOCCG capacity building efforts.

Action 20/15: *Ewa Kwiatkowska to consult with trainers at EUMETSAT to see how they can support IOCCG capacity building efforts.*

There was also consensus that the IOCCG should compile and maintain lists of training courses and workshops related to ocean colour remote sensing on a global scale, designed to further the education of students as well as young researchers and managers.

Action 20/16: *IOCCG to prepare a summary of ocean colour training opportunities, including online courses (H. Dierssen, C. Wilson, E. Kwiatkowska, S. Bernard, V. Stuart, with input from Committee members).*

9.0 Any Other Business

9.1 Developing a New IOCCG Website

The IOCCG has been considering designing and implementing a new and improved IOCCG website that is database driven with a content management system (as opposed to HTML pages), and which would be more navigable, attractive, and informative for a wide range of users. A prototype for a new website was prepared in advance of the Committee meeting (see http://ioccg.spadewerk.com/) and comments were solicited from participants. Many members thought the dummy website was too big size wise, but they liked the clean and professional feel as well as the concept of a non-moving feature image, to be updated with material submitted by agencies. The new website should be mobile compatible, perhaps having the groupings along the top of the page as opposed to the side, and having a password protected area for access by Committee members only. Other suggestions included hiring a graduate student to help organise the material. It was also pointed out that the explanation of the satellite feature image from China should be clearer.

9.2 Any Other Business

At the IOCCG-19 Committee meeting there were preliminary discussions about forming a new IOCCG working group on ocean colour remote sensing of benthic ecosystems. It was noted that Stuart Phinn would stimulate discussion at the upcoming IOCS meeting. Heidi Dierssen mentioned the current call for papers on "Understanding Uncertainty in Remotely Sensed Vegetation Data Products" for a special journal edition of *PE&RS*, which may be relevant. Perhaps IOCCG should consider sponsoring a special issue on select topics in Oceanography

Magazine? It was also suggested that IOCCG publish regular articles in EOS (e.g., when new reports are published, or meetings held). Heidi Dierssen agreed to prepare a brief on the IOCCG-20 meeting.

Action 20/17: *Heidi Dierssen to prepare a brief on IOCCG-20 meeting for EOS.*

10.0 Organisation and Membership

10.1 Rotation of IOCCG Officers

Two scientific committee members officially rotated off the Committee and were thanked for their contributions over the past few years: Zhihua Mao would be replaced by Xianqiang He, and Gene Feldman would be replaced by Bryan Franz. Giuseppe Zibordi agreed to serve a second term. In addition, agency member Juliette Lambin (CNES) will be replaced by Philippe Escudier. All the new members were warmly welcomed onto the IOCCG Committee.

10.2 Proposal to Host IOCCG-21 Committee Meeting

Paula Bontempi announced that NASA and NOAA would host the 2016 IOCCG Committee meeting in the USA. Options to consider for the location were Los Angeles, New York, Washington, New Orleans (back-to-back with the Ocean Sciences meeting), Puerto Rico, Miami (Key West), Phoenix, Seattle, Austin Texas, Santa Fe, Portland or Santa Monica. There were some concerns about holding the meeting on the east coast due to frequent storms. The final decision was to hold the meeting on the west coast (perhaps at JPL in Santa Monica) in late winter/early spring 2016.

Action 20/18: *Paula Bontempi to finalize dates and venue for IOCCG-21 in 2016.*

10.3 Proposals for Hosting IOCCG-22

Nick Hardman-Mountford announced CSIRO's offer to host the IOCCG-22 meeting in Perth in 2017, since David Antoine and himself are both based in Perth. There are several suitable venues in the city: CSIRO has a new building on the University of Western Australia campus which could be used as a possible venue for some of the days (but distant from accommodation), or Rottnest island as a retreat venue. There was also an unofficial expression of interest from the Second Institute of Oceanography, China to host the 2018 meeting in Hangzhou again. Since the IOCCG policy is to hold alternate meetings in a central location (i.e., in Europe/USA in 2018) the proposed Chinese venue would have to be postponed to 2019.

10.4 Closing comments

Stewart Bernard thanked the participants for a very interesting and dynamic meeting, and thanked CNES again for hosting such a successful meeting.

Actions - 20th IOCCG Committee Meeting
Paris, France, 3-5 March, 2015

Action	Brief description	Status
20/1	If interested, Vittorio Brando and Susanne Craig to submit a proposal for a WG with the mandate of revisiting parts of IOCCG Reports 3 and 5, and specifically incorporating the multi-water algorithm concept (due date: 1 June 2015).	Closed
20/2	IOCCG to send an additional supporting letter to Philippe Brunet and Kurt Vandenberghe endorsing the letter sent by Rosalia Santoleri on behalf of the S3VT scientists (S. Bernard, V. Stuart).	Cancelled
20/3	Send invitation letter to Craig Donlon inviting him to chair a panel discussion at IOCS-2015 (S. Bernard, V. Stuart).	Closed
20/4	OCR-VC to provide a redaction of where IOCCG fits into GOOS and also to correct their description of the framework for ocean observing (P. DiGiacomo, S. Bernard)	Closed
20/5	Stephanie Dutkiewicz to attend the GOV MEAP-TT workshop in Halifax to represent the ocean colour modelling community.	Closed
20/6	Stephanie Dutkiewicz to prepare a proposal and draft Terms of Reference for a new IOCCG working group on "Ocean Colour Applications for Biogeochemical and Climate Modelling" by June 2015.	Closed
20/7	EUMETSAT to investigate development of a Sentinel-3 multi-water demonstration product (E. Kwiatkowska).	On-going
20/8	IOCCG Agencies to provide new links to publically available ocean colour data sets, or update the links currently available on the IOCCG website (Venetia Stuart to coordinate).	Closed
20/9	All IOCCG agencies to provide information to Venetia Stuart to update the timelines and specifications for the current and planned lists of ocean colour sensors on the IOCCG website. P. Bontempi, P. Regner and P. DiGiacomo to provide information to CEOS.	Closed
20/10	Paul DiGiacomo to attend the SIT-30 meeting in Paris (31 March – 1 April 2015).	Closed
20/11	Confirm new co-chairs of ECV Task Force (B. Franz, D. Antoine).	Closed
20/12	Jim Yoder's ECV presentation to be included on IOCCG website (V. Stuart).	Closed
20/13	Stewart Bernard and Giuseppe Zibordi to draft requirements for a community AOP/IOP processor for in situ data.	On-going
20/14	IOCCG to send a letter to KIOST/KARI expressing appreciation for GOCI data and for the rapid development of the missions (D. Antoine, S. Bernard, V. Stuart).	Closed
20/15	Ewa Kwiatkowska to consult with trainers at EUMETSAT to see how they can support IOCCG capacity building efforts.	On-going
20/16	IOCCG to prepare a summary of ocean colour training opportunities, including online courses (H. Dierssen, C. Wilson, E. Kwiatkowska, S. Bernard, V. Stuart, with input from Committee members).	Closed
20/17	Heidi Dierssen to prepare a brief on IOCCG-20 meeting for EOS.	Closed
20/18	Paula Bontempi to finalize dates and venue for IOCCG-21 in 2016.	Closed

Appendix I: LIST OF PARTICIPANTS

Paris, France (3-5 March 2015)

IOCCG Members		Affiliation
Antoine, David (Past-Chair)	-	LOV, Villefranche, France
Bélanger, Simon	-	Université du Québec à Rimouski, Canada
Bernard, Stewart (Chair)	-	CSIR, South Africa
Bontempi, Paula	-	NASA HQ, USA
Dierssen, Heidi	-	University of Connecticut Avery Point, USA
DiGiacomo, Paul	-	NOAA/NESDIS/STAR, USA
Dowell, Mark	-	Joint Research Centre, EU, Italy
Dutkiewicz, Stephanie	-	Massachusetts Institute of Technology, USA
Escudier, Philippe	-	CNES, France
Hardman-Mountford, Nick	-	CSIRO, Australia
He, Xianqiang	-	Second Institute of Oceanography, China
Hirata, Takafumi	-	Hokkaido University, Japan
Kwiatkowska, Ewa	-	EUMETSAT, EU, Germany
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