14th IOCCG Committee Meeting

Hangzhou, China, 20-22 April 2009

MINUTES

1.0 Welcome and Opening Session

1.1 Welcome and Opening Remarks

The Chairman, Prof. James Yoder opened the 14th IOCCG Committee meeting, and welcomed all the participants to China (see Appendix I for list of participants). He thanked Prof. Pan Delu for graciously hosting the IOCCG-14 meeting through his laboratory in the Second Institute of Oceanography (State Oceanic Administration), and noted that everyone was very happy to be in Hangzhou. He also thanked the hosts for organising the International Ocean Colour workshop following the IOCCG-14 meeting, and for hosting a number of events and banquets for IOCCG-14 participants. Sincere thanks were also conveyed to Dr. Bai Yan for all her help in organising the meeting, and also all the students and employees who helped with the arrangements.

The Chairman noted that three IOCCG members were rotating off the Committee at the end of the meeting: Pan Delu (SIO, China), Srinivas Kumar (INCOIS, India) and Heidi Sosik (WHOI, USA), and he thanked them for their service on IOCCG Committee. He also welcomed the new IOCCG Committee members: Scarla Weeks (University of Queensland, Australia) who was nominated last year but was unable to attend the meeting, and Tasuku Tanaka (Yamaguchi University, Japan) and Zhihua Mao (Second Institute of Oceanography, China) who were nominated this year.

Prof. Pan Delu then addressed the Committee and extended a warm welcome to all participants on behalf of the Director-General of the Second Institute of Oceanography, Dr. Haisheng Zhang. He noted that there were two paradise cities in China, one of which was Hangzhou with its famous West Lake. Hangzhou was also noted for its hospitable and friendly people. He thanked the IOCCG for its support for China and hoped that the IOCCG-14 meeting would be fruitful and successful.

1.2 Adoption of agenda

The agenda was adopted with two minor modifications: Yves Crevier (CSA) and Srinivas Kumar (INCOIS) were unable to attend the meeting at the last minute, so Agenda Item 5.5 (CSA) would be given by Trevor Platt and James Helbig. No presentation would be given for Agenda Item 5.9 (ISRO).

1.3 Adoption of the minutes from the 13th Committee meeting

The record the 13th IOCCG Committee meeting was approved as written.

1.4 Status of action items arising from 13th Committee meeting

The Chairman summarised the status of the actions from the 13th Committee meeting, most of which had either been completed, or would be addressed later in the meeting.

Action 13/1: Agency representatives to meet on Day-2 of the IOCCG-14 meeting (OCR-VC).
Action 13/2: Draft Ecological Provinces report completed and available for review.
Actions 13/3- 13/6: These actions related to IOCCG Report 7 – completed and report published.
Action 13/7: Aneesh Lotliker had been proposed by INCOIS as candidate for BIO-Argo WG.
Action 13/8: Cyril Moulin had stepped down as Chair of the PFT working group and Shubha Sathyendranath had been appointed as the new Chair.
Action 13/9: This action was superseded by the ability for users to request 1-km resolution products via the GlobColour data service and the future CoastColour project.
Action 13/10: KARI's data policy would be addressed at the OCR-VC meeting (Day 2).
Action 13/11: Wikipedia entry to be addressed under Agenda Item 6.3

2.0 Status of IOCCG Scientific Working Groups

2.1 Why Ocean Colour report and brochure

Trevor Platt noted that the IOCCG Report 7 on this topic had been printed by ISRO and he thanked Rangnath Navalgund and Srinivas Kumar for their support. He also thanked all the authors who contributed text at last minute. At the last IOCCG meeting, there was considerable discussion regarding an Executive summary, and it was agreed that a popular brochure should be published (sponsored by CSA) summarising the outcomes of the monograph. The brochure was very well received and had already been published in Spanish and Portuguese with the help of CONAE and INPE. Translation into other languages such as French, Korean, Chinese or Japanese was encouraged. He noted that it was important to ensure that the brochures were distributed broadly in Latin America, Spain and Portugal and requested IOCCG members to suggest appropriate senior government contacts.

ACTION 14/1: IOCCG MEMBERS TO PROVIDE ADDRESSES OF SENIOR POLICY MAKERS IN LATIN AMERICA, SPAIN AND PORTUGAL TO WHOM BROCHURES SHOULD BE SENT.

Yu-Hwan Ahn (KORDI) and Pan Delu (SIO) expressed an interest in producing Korean and Chinese versions of the brochure respectively. The IOCCG Chairman congratulated Trevor Platt, Yves Crevier and colleagues for taking the initiative to prepare a brochure and noted that it was very important to have a concise summary.

2.2 Ecological Provinces working group

Mark Dowell informed meeting participants that a complete draft of the provinces report had been distributed to Committee members for review, and he requested feedback regarding content by mid-May 2009. Some harmonising between chapters was still required, and there were a few missing references and figures. JRC had agreed to fund the printing of the report as a contribution to IOCCG, and it was anticipated that the report would be published in Fall 2009.

The new title of the report was "*Partition of the Ocean into Ecological Provinces: Role of Ocean Colour Radiometry*". The report would constitute one of the IOCCG deliverables (via the OCR-VC) to GEO Task EC-09-01a (Ecosystem Classification). An example was given showing global persistence of various optical water types over time, which was useful for selecting cal/val sites. A number of applications were considered including retrieval of phytoplankton biomass, biogeochemistry and climate modelling, and marine resources and biodiversity. A number of recommendations were also proposed including advocating for

development and calibration of regional algorithms using the provinces as an underlying template, and the development of guidelines for the selection of optimal partitions to address oceanographic questions at different scales.

It was noted that within the GEO context, sections of the report would be a useful tool for application to a number of GEO Tasks, and could also feed into GCOS, or act as a tool to analyse Essential Climate Variables (ECVs). A recommendation was made that the report should be distributed to the GCOS Secretariat.

ACTION 14/2: DISTRIBUTE ECOLOGICAL PROVINCES REPORT TO GCOS SECRETARIAT.

A discussion regarding GCOS then ensued, and Committee members agreed that it was essential for the IOCCG to be tied to GCOS, and that further discussions were required regarding how IOCCG could further contribute to GCOS and GOOS. Paul DiGiacomo noted that it was crucial to have an IOCCG representative on the Ocean Observations Panel for Climate (OOPC), a scientific expert advisory group charged with making recommendations for a sustained global ocean observing system for climate, sponsored by GCOS, GOOS and the WCRP (see also Agenda Item 7.3).

ACTION 14/3: NOMINATE AN IOCCG REPRESENTATIVE FOR the OCEAN OBSERVATIONS PANEL FOR CLIMATE (OOPC).

2.3 Atmospheric Correction Algorithms working group

Menghua Wang reported that the Atmospheric Correction Working Group consisted of seven active members and had been in existence for a while, but the final draft manuscript was now ready for review. For global ocean-colour products, four global datasets had been selected: SeaWiFS/MODIS, MERIS, OCTS/GLI and POLDER. All comparison algorithms were operated using the same spectral bands of 443, 490, 555, 765, and 865 nm (some algorithms had to be modified slightly for this purpose). The final report would consist of seven chapters, plus a number of appendices providing a complete reference with all the relevant details.

A number of conclusions and recommendations were tabulated. For open ocean Case-1 waters, all four operational atmospheric correction algorithms performed well in deriving the nL_w spectra and radiance ratio values. However, some *in situ* validation results showed that further improvements were still needed, in particular for nL_w at the shorter blue band (412 nm). For sediment-dominated Case-2 waters, all four operational algorithms produced errors in the nL_w in the blue bands, mainly due to the incorrect estimation of the NIR ocean contributions. It was suggested that the longer visible bands be used for retrieval of the sediment-dominated water optical and biological properties. All four operational algorithms performed poorly for yellow substance-dominated Case-2 waters. It was proposed that the spectral shape of nL_w may be helpful for deriving water properties of yellow-substance dominated waters. Furthermore, all four algorithms failed to produce accurate nL_w for strongly absorbing aerosols. In such cases, the aerosol vertical distribution was required *e.g.* from Lidar measurements.

2.4 Ocean Colour from a Geostationary Platform working group

David Antoine briefed the Committee on the new IOCCG WG on Ocean Colour from a Geostationary Platform. He noted that remote sensing tools were currently covering the globe

on a scale of around 1 km, and at time scales of every few days to one decade. However, the ocean was very variable at smaller scales, so observation systems should measure at smaller temporal scales. To understand the Earth's ecosystem, variations in the seasonal cycle should be resolved, as well as variations in the diurnal response cycle. The motivation behind the formation of the IOCCG working group was that several projects had been submitted to various agencies (ESA, NASA, CNES) in the past decade for geostationary platforms, and one was scheduled for launch (GOCI on COMS-1, from Korea). The interest for such observations was growing, and other missions might be decided within the next 5 years, so it was important for the IOCCG to contribute by setting up requirements, advocating for coordination and fostering collaboration among the Agencies. The Terms of Reference for the WG were reviewed, and membership discussed. The first meeting of the WG took place in Korea (1 November 2008), sponsored by KORDI which was gratefully acknowledged. An outline of an IOCCG report was drafted at the meeting, and contributions would be received until the end of August 2009. A draft report should be available by the end of this year. The report would include chapters on science questions and applications, requirements for ocean colour observations from a geostationary platform, calibration requirements, algorithm specificities and synergistic aspects.

ZhongPing Lee pointed out that it was important to demonstrate the extra capabilities of GEO missions, when compared with a series of LEO missions, *e.g.* no inter-calibration issues, in order to convince the community of the great values of a GEO system.

2.5 Bio-optical Sensors on Argo Floats working group

Stewart Bernard gave a presentation on the status of the BIO-Argo WG on behalf of Hervé Claustre. He noted that remote sensing was a powerful tool, but there were some limitations *i.e.* observations were restricted to the upper ocean layer, cloudy areas were unobservable by remote sensing and calibration / validation was essentially dependant on moorings or cruises. To reach its full potential, remote sensing had to be complemented with other techniques, such as the Argo profiling floats. In the last few years, several low cost instruments had been incorporated on this type of platform. The BIO-Argo WG was involved in the preliminary steps before envisaging a BIO-Argo program.

The group met twice over the past year (February and November 2008, Villefranche). The principle recommendation from these meetings was that three types of Argo-like floats were necessary for bio-optical / bio-geochemical activities: the CAL-VAL float for validation activities (~$40K/float), the BIO-Argo float for biogeochemistry and validation (~$25K per float) and the Carbon-float for biogeochemistry. The CAL-VAL float matched the Terms of Reference for the group, the BIO-Argo float met the needs of a broader biogeochemical community, while the Carbon-floats offered a wider and more complete range of biogeochemical measurements, some of which were also useful for the bio-optical community. At the last WG meeting, the group debated whether the Carbon-float should be part of their recommendations as it did not fit in well with a global array of the Argo type, or with the IOCCG mandate, and the group welcomed recommendations from the IOCCG Committee.

The ultimate goal was to maintain a network of 10-20 floats, the preparatory phase of which was already ongoing. Various groups (most of them represented in the WG) were developing and testing various configurations of floats. A pilot study was recommended to initiate interactions with other groups (*e.g.* friends of oxygen on Argo). Further discussions would take

place at a scoping workshop to be held in Monterey (28-30 April 2009), as well as at the OceanObs'09 meeting for which a White Paper had been submitted by the BIO-Argo WG. A draft IOCCG report was in preparation and would be available for comment and discussion by the end of June 2009.

Paula Bontempi informed the Committee that NASA was still interested in funding a pilot BIO-Argo study for the IOCCG, especially since the data would be useful to study carbon cycle processes. She noted that a major concern was purchasing the instruments from private companies. Instrument manufacturers would require direction, and would have to ensure sustainability. She recommended establishing protocols for carbon cycle processes as well. David Antoine suggested that the WG should specifically address validation and characterisation of the instruments. André Morel noted that, in the report, it would be useful to have an estimate of the cost of biogeochemical data from an Argo float compared to the cost of obtaining similar data from a ship. See Agenda Item 7.3 for further discussions on the topic.

2.6 Phytoplankton Functional Type (PFT) working group

Shubha Sathyendranath reported that the WG had made some progress since the last meeting: a first draft of Chapter 1 of the report was complete and provided an introduction and background to PFTs. Chapter 2, dealing with complementary *in situ* methods of measuring phytoplankton functional types, was in preparation, while the rest of the report was still in the planning stages. Chapter 3 would deal with various remote-sensing algorithms used to look at functional types, while Chapter 4 was the more analytical part of report, and would examine how various approaches were complementary to each other, and the advantages and disadvantages of each method. The WG was avoiding a timeline but would complete their work as fast as possible, mostly via email.

Roland Doerffer suggested that Astrid Bracher (Alfred-Wegener-Institute) might be a useful member of the WG, and the Chairman enquired whether it would be useful to have a meeting of a small subset of the group to make things move faster. This was something that would be considered.

2.7 Calibration of Ocean-Colour Sensors working group

Robert Frouin had notified the Chairman that he had not been able to do anything significant for the IOCCG calibration report since last year, although he was committed to finishing the report. Only half a chapter remained to be written, as well as a general introduction and final recommendations. He would contact the Chairman upon completion to see if the IOCCG would still consider publishing the final report. If not, he intended to publish the material elsewhere.

Trevor Platt enquired whether the text already prepared could be integrated with, or appended to, another active working group. Paula Bontempi agreed that this was an important working group and an important topic, and that it was essential to get the material published as there was not much in the literature in this field. The consensus was that the Committee should wait to see the completed report. It was also suggested that the completed draft chapters of the report be placed on the IOCCG website for review by the Committee.

ACTION 14/4: COMPLETED DRAFT CHAPTERS OF CALIBRATION REPORT TO BE PLACED ON IOCCG WEBSITE FOR REVIEW AND COMMENT.

3.0 Proposals for New IOCCG Working Groups and Related Projects

3.1 Revisiting IOCCG Report 1: Level 1 Requirements

Paula Bontempi presented a proposal for a revisit of the first IOCCG report on Level 1 requirements (*Minimum Requirements for an Operational Ocean Colour Sensor for the Open Ocean*) which was published in 1998. She pointed out that perspectives had changed dramatically over the past 10 years. It was now possible to measure more complex ocean variables, as well as physiological features of phytoplankton using ocean colour radiometry. All sensors listed in Report 1 (apart from SGLI) had already been launched. Much of Robert Frouin`s report on calibration could be included in this revisit since it was so relevant to the topic. She noted that it was not necessary to address products, but rather top-of-atmosphere radiances, since a range of products could be recreated from that suite.

In mission planning at NASA, a Science Traceability Matrix (STM) is usually assembled, and for ocean biology the minimum requirements have changed. New ocean radiometers require many more bands. Dr. Bontempi recommended starting with science questions and ocean properties that we can measure, and then updating the current suite of requirements as listed. She noted that it would be good to be able to list requirements on one page. The proposed report should also include pre-launch and on-orbit requirements including vicarious calibration and on-orbit calibration. Furthermore the report should also address desired measurements for which there is no capability at the present time *e.g.* mixed layer depth. There was some discussion as to whether the new report should be an update of Report 1, or a completely new report. It was agreed that the requirements in the first report were written for chlorophyll only, so a new report was required since the range of applications had multiplied.

3.2 Information on ESA's global monitoring of Essential Climate Variables (ECVs)

Peter Regner reported on a new ESA initiative on climate change. There are many indications that climate is changing on a global scale *e.g.* sea level rise, increased mean global temperatures as well as increased SST. The demand for accurate satellite data continues to grow, so ESA was responding with a number of research-driven missions, plus operational or service-driven missions. Climate is part of Earth Watch, the operational component which includes GMES and its suite of 5 Sentinel missions. A total of 44 ECVs were defined in the GCOS 2006 document, and ESA missions play a primary role in 21 ECVs. Elements of the ECV relevant to ocean colour defined a normalised water-leaving radiance in the visible spectrum, temporal resolution, daily coverage etc.

ESA’s new Climate Change Initiative was recently approved by ESA Member State Ministers (November 2008). The scope of the initiative was to systematically generate, preserve and give access to long-term data sets of ECVs to meet the needs of UNFCCC and IPCC. The first step was to collect all available data and perform rigorous re-processing to get input for generating the most comprehensive global, long-term records possible. The ECV outputs must be internationally accepted, adhering to agreed standards, and delivered in a form amenable to the

modelling community for assimilation and assessment in climate models. Programme activities would be carried out in cooperation with international partners such as GCOS, international climate research programmes, CEOS etc. The ESA Climate Change Initiative (CCI) would be ready to start at the end of 2009. It would focus on those ECVs for which data from ESA and relevant national missions are of particular importance. Close interaction with climate modelling community was crucial.

Roland Doerffer commented that water-leaving radiances were the way to create a whole suite of products, and André Morel pointed out that the ECV should be TOA radiance instead of water-leaving radiance, since the atmospheric correction could change, so the real basic information was TOA radiance. Paula Bontempi concluded that there should be a community consensus – ESA ECVs should be the same as NASA ECVs etc. The opportunity to expand into GCOS requirements was important and could be related to the OCR-VC.

3.2 Proposal for a new WG to address Regional Algorithms

Mark Dowell outlined a proposed initiative on regional and class-based algorithms. There was a need to describe the variability in parameterising inversion algorithms so they are applicable at the global scale, but remain quantitatively accurate for both the open ocean and coastal / shelf seas. There was also a need for information on product uncertainties at the regional scale. Components of the initiative would consist of a live, map-based bibliography of regional algorithms rather than a traditional IOCCG report. It would also include a series of white papers/protocols (~5-10 pages) documenting agreed approaches for implementing new regional algorithms as well as a "round-robin" activity comparing different regional and class-based approaches with global/standard products. It was envisaged that the activity could start at the beginning of 2010 and would be completed in 24-36 months.

Parallel/complementary activities included the NASA community semi-analytical algorithm workshop (Barga, 2008), the ESA Case 2R processor in BEAM and CoastColour initiative, the GEO Water Quality Algorithm Workshop (May 2009) and GEO regional networks including ChloroGIN and the OCR-VC. Added value of the proposed WG would be the production of regional uncertainty estimates as well as a capacity building element. Several tutorials on this topic would be given at the upcoming IGARRS 2009 session. Resources would be required for one large workshop plus a smaller workshop, plus website development including updating and maintenance. JRC might be able to provide some resources.

Shubha Sathyendranath pointed out that the ChloroGIN model, consisting of a nested network of networks, might provide an ideal format for this type of activity. David Antoine was not clear what type of information could be provided from this initiative and Roland Doerffer noted that the biggest problem was atmospheric correction. ZhongPing Lee commented that in addition to regional algorithms, it was also necessary to pay attention to temporal/seasonal variability in algorithms or algorithm coefficients, as regional and temporal variations could be equally important. André Morel suggested that the first move would be to identify an interested community by organising a special session on regional algorithms in an international symposium such as Ocean Optics. This proposed WG would be further discussed during the Executive meeting.

3.3 Proposal for a new Harmful Algal Bloom (HAB) WG

Stewart Bernard outlined a proposal for a new IOCCG working group on ocean colour and Harmful Algal Blooms. A great deal of work had been done on the potential of ocean colour radiometry to detect HABs, but there was a need to objectively identify both the benefits and shortcomings of current and emerging HAB-focused, ocean-colour methods, as well as producing a "consumer's guide" for ocean-colour approaches in different ecosystems. The structure of a potential IOCCG report was outlined, and it as noted that there was some overlap with the PFT working group, as well as links with the GEO Coastal and Inland Water Quality algorithm group. It was proposed that the WG could be a joint initiative with GEOHAB. Heidi Sosik commented that the proposal seemed to be very ambitious. This WG would be further discussed in the Executive meeting.

3.5 Proposal for a new WG on "In situ radiometry for satellite ocean-colour applications"

Nicolas Hoepffner pointed out the importance of *in situ* radiometry measurements which were essential to ensure high quality satellite products. These measurements were used for vicarious calibration of space sensors, for the development of algorithms to retrieve in-water constituents, and were also important for validation of space-derived radiometric products. The subject matter was quite mature and could provide a valuable IOCCG report. The objective of the ensuing report would be to identify optimal *in situ* radiometric measurements that could satisfy all applications. New methodologies were available which could complement the technical aspects of measurements. Issues to be addressed could include radiometric concepts, measurement and data reduction methods, calibration requirements, technology overview, applications and uncertainties. Guiseppe Zibordi (JRC, EU) was proposed as a Chair for the working group.

The Chairman noted that this was a complementary approach to Jim Muller's technical reports for SeaWiFS. David Antoine suggested approaching the National Institute for Science and Technology (NIST) for funding. André Morel queried the real need for such an activity, since even now the protocols were not routinely followed. He was not convinced that technology had changed so much that revised protocols were necessary. Roland Doerffer pointed out that protocols were frequently misused, and that more emphasis should be placed on issues that were very important. Paula Bontempi noted that there was a lot of potential overlap and redundancy, and that a better way should be found to coordinate all these activities and involve all agencies. She suggested that IOCCG should endorse an international round-robin - separate groups should not endorse their own protocols. This would be further discussed in the Executive Meeting.

3.6 Proposal to motivate for ocean-colour related measurements on routine global hydrographic surveys

Shubha Sathyendranath informed the Committee about the activities of the GO-SHIP Panel which was developing a strategy for a sustained global programme for ship-based repeat hydrography. She noted IOCCG had made some progress on an *ad hoc* basis in getting the hydrographic community to recognise that bio-optical measurements should be standard part of sustained repeat hydrography. The GO-SHIP Panel had submitted a White Paper to OceanObs'09, some sections of which were relevant to IOCCG. Some elements of the

coordination and implementation of repeat hydrography programmes could benefit from a more pro-active oversight structure including the development of an international coordination body for integrated repeat hydrography that was independent of any specific research program (e.g. Argo), and coordinated international data management activities.

Data from repeat hydrography could be used test and validate satellite ocean-colour measurements from different sensors, as well as develop and improve regional algorithms for satellite-derived estimates of phytoplankton biomass and primary production. The data was also useful in modelling global carbon-cycling, as well as monitoring the distribution of various phytoplankton types to evaluate their response to climate change (*e.g.* ocean acidification). It was desirable to measure a comprehensive suite of bio-optical parameters, including pigment measurements, on future hydrographic cruises to quantify the underwater light environment and to obtain better estimates of phytoplankton standing stocks and production (and thus carbon flux). Ideally POC, phytoplankton pigments and absorption, and number and size of phytoplankton and other microbial cells by flow cytometry should be measured at all sampling stations, at different depths down to the 1% light level. In addition, PAR measurements should be included on the CTDs where practicable, and irradiance should be measured at specific wavelengths. Repeating the hydrographic cruises in different seasons would also be highly desirable. The draft GO-SHIP White Paper endorses the recommendations of IOCCG and the IOCCG Committee was requested to read the relevant section, and provide feedback.

ACTION 14/5: IOCCG COMMITTEE MEMBERS TO READ BIO-OPTICAL SAMPLING STRATEGY IN DRAFT GO-SHIP WHITE PAPER AND PROVIDE FEEDBACK TO SHUBHA SATHYENDRANATH OR VENETIA STUART.

Dr. Sathyendranath also briefly drew attention to the ChloroGIN community White Paper. She noted that ChloroGIN was enabling and promoting use of Earth Observation and *in situ* data in support of marine ecosystems and development of GOOS. ChloroGIN aims to bring together regional satellite data processing centres in developing and developed countries and also includes complementary time-series *in situ* data. All sites were measuring chlorophyll, temperature and light, which represented the three core variables of GOOS.

The Chairman enquired whether the repeat hydrography issue warranted the formation of an IOCCG working group, but this was declined. Ideally, all the space agencies should get together and think about the issues to see whether there was something that could be done in a coordinated fashion outside existing research programmes. A committee, if established, should be a standing committee that would meet to review requirements and make recommendations through the web. Paula Bontempi noted that there were many opportunities, and a lot of work to be done in standardising protocols etc. The community should be clear on what was required and there should be a coordinated response. See Agenda Item 7.3 for further discussions on the topic. This item would also be further discussed in the Executive committee meeting.

4.0 Other Remote Sensing Activities

4.1 Coastal remote sensing including links with ISPRS

Samantha. Lavender briefed the Committee about the International Society for Photogrammetry and Remote Sensing (ISPRS) – an organisation of national societies and organisations. There were a number of technical commissions with working groups that undertake various activities. Ocean colour fell within WG VIII/9 (Oceans) of Commission VIII led by Japan, although there was not a large involvement. Joji Ishizaka and Samantha Lavender were co-chairs of this working group, and the Terms of Reference included coordinating present and future space missions related to ocean observation and the calibration/validation of the data. Dr. Lavender pointed out that the working groups were encouraged to have their own meetings and that funding could be obtained from the ISPRS Foundation if there was a clear mandate. Several people were involved in the GEO "Inland and Nearshore Coastal Water Quality" group.

The Chairman suggested that if there was an opportunity for co-sponsorship of a workshop on inland waters, that Dr. Lavender should put forward a proposal. It was also possible that the GEO workshop in May could come up with some recommendations to bring the two communities together. The Chairman noted that if the inland/nearshore group were interested in the same type of sensors, it made sense to arrange a workshop together. Trevor Platt suggested that IOCCG invite them to convene a working group to address their issues. Paul DiGiacomo noted that there was some concern that IOCCG was not addressing the requirements for remote sensing of inland waters, but was only focussing on the oceans. The Chairman requested Drs. Lavender and DiGiacomo to advise IOCCG of the best way forward and to make a recommendation for IOCCG.

ACTION 14/6: SAMANTHA LAVENDER AND PAUL DIGIACOMO TO OBTAIN RECOMMENDATIONS FROM PEOPLE INVOLVED IN THE GEO INLAND AND NEARSHORE COASTAL WATER QUALITY WORKING GROUP REGARDING REQUIREMENTS FOR REMOTE SENSING OF INLAND WATERS

4.2 Ocean colour activities at SIO, China

Prof. Pan Delu Pan briefly introduced the State Key Laboratory of Satellite Ocean Environment Dynamics (SOED) which operates out of the Second Institute of Oceanography (SIO) of the State Oceanic Administration (SOA), China. The ocean-colour remote sensing group of SOED consisted of 4 senior scientists, 1 academician plus 24 M.Sc/ Ph.D students. The group was responsible for receiving, processing and archiving satellite data, and also conducted research on algorithm development, atmospheric correction, calibration studies and development of the Chinese ocean-colour satellites. Their ground station automatically received data from 10 different satellites and generated 18 different kinds of products. All the IOCCG-14 participants were then taken on a tour of SOED facilities.

5.0 Agency Contributions to the OCR-VC Implementation Plan

5.1 Background to the establishment of the OCR-VC and IOCCG's contributions to GEOSS

The Chairman reported that he had attended the various SIT meetings on a regular basis, and that a draft Implementation Plan (IP) for the Ocean Colour Radiometry-Virtual Constellation (OCR-VC) had been developed**.** It was imperative that this Implementation Plan had the full

support of all agencies. The draft IP covered Phase 1, up until the launch of Sentinel-3, and was intended to support various societal benefit areas of GEO, as well as GCOS requirements. Ocean-colour radiometry was important in understanding climate and climate impacts, and was relevant to a number of societal benefit areas, so the OCR-VC was an opportunity to encourage cooperation amongst the space agencies represented in IOCCG. Agency activities that helped with the broader goals and objectives of the OCR-VC could be listed as part of the initiative. CEOS had accepted the leadership of the OCR-VC by agency representatives Hiroshi Murakami (JAXA) and Nicolas Hoepffner (JRC, EU), but all agency members were expected to contribute to the Implementation Plan, the final version of which would be ready for review/approval prior to SIT-24 (September 2009).

5.2 NASA update

Paula Bontempi reported that NASA would undertake a reprocessing of the full suite of sensors within the next few months (MODIS-Aqua, MODIS-Terra, SeaWiFS, OCTS and CZCS). Highlights of the reprocessing would include sensor calibration updates, updated aerosol models based on AERONET size distributions, updated vicarious calibration, updated MOBY dataset etc. Lunar calibration trends for SeaWiFS had begun to deviate from the exponential model in 2006, and the satellite had drifted from noon to approximately 1:30pm orbit, which was being addressed. The band center of MODIS-Aqua had been moved from 551 nm to 547 nm and the instrument calibration had been updated. These changes resulted in reduced discrepancy between MODIS-Aqua and SeaWiFS chlorophyll in oligotrophic waters, and also reduced the high-latitude seasonal differences in MODIS-Aqua vs. SeaWiFS water-leaving radiance trends. MODIS-Terra had well documented issues with radiometric stability which had taken a long time to sort out. Reprocessing would start June 2009, and the fully reprocessed data sets should be available to the research community by Fall 2009. This was the first complete end-to-end re-evaluation and update of ocean colour processing methodology, radiative transfer tables, sensor calibration, ancillary sources, file formats, etc. and was a very big job. It was also noted that all sensors were beyond their planned mission life.

An IOP Algorithm workshop was held at Ocean Optics XIX (3-4 Oct 2008) to achieve community consensus on an effective algorithmic approach for producing global-scale, remotely-sensed IOP products from semi-analytic algorithms (SAA). Participants reached consensus on a processing framework within which NASA would start producing SAA data products for community evaluation. Following the reprocessing, global IOP products would be generated and distributed in a parallel evaluation data stream, with source codes available via SeaDAS.

The fifth SeaWiFS HPLC Analysis Round-Robin Experiment (SeaHARRE-5) was being conducted with an emphasis on coastal (Case 2) waters. It was noted that the problems with the historic HPLC data in SeaBASS had been corrected, and the data would be put back in SeaBASS within the next few months. Dr. Bontempi also announced that she would be willing to request NASA to undertake the processing of HPLC samples from ChloroGIN or GO-SHIP. NASA planned to hold an Apparent Optical Property (AOP) data processing workshop to specify the requirements of a community-maintained, web-based interface for the processing of AOP data.

ESA/NASA partnerships had been strengthened: Bryan Franz and Gerhard Meister represented NASA on the MERIS Data Quality Working Group. In addition, the NASA Ocean Biology Processing Group had formally applied (as a group) to be one of the "Champion Users" for MERIS full resolution coastal data (CoastColour). SeaDAS had been enhanced to support the display and analysis of standard MERIS Level-2 products.

NASA and NOAA were interested in ISRO's Oceansat-2 OCM data (as well as scatterometer data). ISRO had agreed to provide online access to global OCM-2 data (4-km) at Level-1B, to all international users for research use at no cost. NASA would provide processing capability (Level-1B through Level-3) for use by ISRO and the international community (distributed in SeaDAS). NASA and NOAA would also participate in a joint Cal/Val Team.

NASA had plans for 16 new missions by 2025. The ACE (Aerosol, Cloud, Ocean Ecosystem) Mission would include an aerosol-cloud component, as well as an ocean ecosystem component to characterize and quantify changes in the ocean biosphere, and to characterize the role of the oceans in the carbon cycle. For ocean ecosystems, the ACE payload was considering an ocean colour multi-channel spectrometer with 22 aggregate bands (5 nm resolution) from 335 to 865 nm, plus 3 SWIR bands. The ocean-colour component could be developed in conjunction with Earth Care and launched in 2012, otherwise it would be launched in 2018. Other planned missions included a Geostationary Coastal and Air Pollution Events (GEO-CAPE) Mission (launch 2013-2016) to examine coastal ecosystem health and air quality, and the hyperspectral HyspIRI Mission which would be used to produce the first ever global measurements of ecosystem function and composition. Its focus would be on land vegetation, but there was an interest in doing ocean retrievals for phytoplankton physiology. The tentative launch date was around 2014. Another instrument being developed at NASA was the ocean colour aircraft-based PRISM instrument, to identify constituents and quantify properties of complex coastal ocean waters using spectroscopic measurements with UV to SWIR channels.

NASA was funding a range of research programmes from development of algorithms to remotely-sensed inland and coastal water quality, to the development of new sensors for marine ecosystems. NASA agreed to support the OCR-VC in its entirety.

5.3 NOAA contributions to implementation of the OCR-VC

Paul DiGiacomo reported on NOAA's contribution to the five main objectives of the OCR-VC Implementation Plan. Regarding "Ensuring OCR Continuity", the launch of VIIRS-NPP was anticipated for the first quarter of 2011. A supporting interagency Cal/Val Program for VIIRS ocean products (ocean colour and SST) is now in execution phase, with three goals: 1) validation of NPOESS program delivered ocean products, 2) evaluate the usability of VIIRS data and products for operational and scientific use by the agencies and 3) evaluate the VIIRS products in relation to the heritage instrument products with the goal of producing comparable products and combining heritage instrument and VIIRS products to assess climate variations. VIIRS-NPOESS will be launched in 2013 or 2014 and anticipated updates include an improved filter, improvements in spectral out of band characterization, and algorithm improvements.

To fulfill the objective "Provision of high quality data sets", all data from MOBY are now freely and openly available free of charge via the NOAA-CoastWatch website, and have been/will be incorporated into SeaBASS. The next generation MOBY (i.e., MOBY-C) has

been presented to NOAA / NESDIS management and could possibly be ready for deployment by 2011. MOBY-C would support vicarious calibration of current and future satellites, and has a number of advantages over MOBY (simultaneous measurements, high data rate, more flexible design and more portable).

Regarding "Data Harmonisation", NOAA CoastWatch participated in the ESA CoastColour meeting, and they intend to continue working with ESA. Several US regions were put forward as potential test-sites for evaluating MERIS FR data products in coastal waters. NOAA also participated in an expert meeting on updating the GCOS Implementation Plan.

To fulfill the objective "Facilitating Timely Access to Data" the NOAA CoastWatch programme has set up a new website to facilitate easier and quicker user access to data through a variety of mechanisms (applications portal, OceanWatch portal etc.). VIIRS NPP and NPOESS ocean colour data will be distributed by via both NOAA CoastWatch and OceanWatch, in addition to other NOAA portals. Furthermore, NOAA were now distributing MERIS NRT reduced-resolution products for U.S. coastal waters via CoastWatch, and were also initiating efforts toward distribution of MERIS full-resolution data for U.S. coastal waters.

Regarding the "Capacity Building and Outreach" objective of the OC-VC, the GEOSS Coastal Zone Community of Practice (CZCP) was bringing together data providers and users in the context of GEOSS, to ensure that user coastal observational needs are coordinated and addressed (co-chaired by Paul DiGiacomo and Hans-Peter Plag). A series of regional user workshops are also underway. A number of activities are also addressing remote sensing of water quality including the GEO Inland and Coastal Water Quality Remote Sensing Algorithm Workshop, (19-21 May 2009, Washington, DC). A draft report of the workshop should be ready by the end of summer.

5.4 ESA: Status of MERIS and Sentinel-3, GlobColour and CoastColour Programmes

Peter Regner informed the Committee that the main limiting factor of the Envisat mission was onboard fuel. A new orbit control strategy (lowering by 17.4 km) would allow the "nominal mission" to continue until 2010, and would ensure continuity of most Envisat applications until 2013. No significant impact was expected for MERIS products. The MERIS instrument was still very stable with excellent performance. With the current ageing rate, the required radiometric accuracy of the instrument and the on-board diffusers could be maintained until 2013. The MERIS Quality WG had been working with experts from MODIS and SeaWiFS on instrument characterization, Cal/Val methods and algorithm development. The MERMAID database was used to support worldwide activities on Cal/Val. The third reprocessing of MERIS would be completed by December 2009 with a number of significant improvements.

ESA's GlobColour Project, initiated in 2005, provided a consistent long time-series (10 years) of ocean-colour information by merging together data streams from SeaWiFS, MERIS and MODIS. There were 21 official parameters and 4 demonstration products with improved spatial and temporal coverage (removal of clouds). Data were freely available via two portals: Hermes plus an ftp server. GlobColour products were being intensively used by a significant number of users. ESA funding for GlobColour would end in July 2009, after which the time-series production would continue as part of EC GMES Marine Core Services *i.e.* MyOcean. Users had requested a coastal version of GlobColour, as a result of which the CoastColour project was

initiated. This new Data User Element (DUE) project for 2009 had been established to increase the use of MERIS data in Case 2 coastal waters. The first User Requirements workshop was held in Ireland (March 2009) and was well attended. The next step was asking "Champion Users" to provide detailed user requirements and to advise ESA during the execution of the project. The project should be completed by the end of 2011.

The OLCI instrument on the Sentinel-3 spacecraft will have a number of improvements over MERIS, including tilting to avoid sun-glint, more spectral bands (21 instead of 15) and a 2% absolute radiometric accuracy. EUMETSAT will be the operator for ocean ground segment, while ESA will handle the land ground segment. The Sentinel data policy was in preparation and would ensure open and free access to the data. Funding for the GMES Space Component Programme was on solid financial ground and had been approved by ESA Member States.

David Antoine gave a brief report on vicarious calibration activities and the MERMAID database. MERMAID is a centralized database of *in-situ* optical measurements with concurrent MERIS acquisition, which facilitates the assessment of MERIS Level-2 marine products delivered by the ground segment. The project was initiated in 2008 and was partially supported by ESA. Data access was given to MERIS QWG members as well as scientists contributing *in-situ* data to the database. ARGANS was in charge of the data formatting while ACRI-ST was in charge of the final delivery on the web site. MERMAID would be one of the tools used for validating the next reprocessing of MERIS data.

5.5 CSA: Reception of MERIS data in Canada, SAFARI Project

Trevor Platt reported on the SAFARI initiative on behalf of Yves Crevier, who was unable to attend the meeting. This initiative was funded by CSA, and was addressing one of the GEO tasks within the societal benefit area of agriculture. SAFARI represented an international forum for coordination and exchange of views on the use of remotely-sensed data in fisheries oceanography, and intended to stimulate new research and knowledge in this area. In addition, there was a capacity building element, with outreach to fishermen, which would be good to do in other countries as well. An informative brochure on this topic had been published, which could be translated into other languages if there was interest. The group was also publishing a monograph in the IOCCG series, which would be printed soon. The next initiative would be an international symposium on remote sensing and fisheries, scheduled to take place in Kochi, India (15-17 February 2010). Dr. Platt was optimistic about Phase 2 of the project, and welcomed broader participation by other countries, as well as suggestions.

Jim Helbig gave the second half of Yves Crevier's presentation on MERIS reception in Canada. CSA had reached an agreement with ESA for MERIS reception in Canada, which was being implemented in two phases. Data is being downlinked via two ground stations in Canada (Prince Albert and Gatineau) where it is processed to Level 0, then sent to Kiruna in Sweden. Phase 1 consisted of repatriating the data via the internet, and using existing PDS infrastructure to provide a 'same day' MERIS FR L1 / L2 service for Canadian-acquired data. This service is working well. Phase 2 had been delayed because of hardware and software problems but would be implemented by October 2009, and would encompass deployment of a Linux-based MERIS processing chain and rolling archive directly in Canada. The data policy was the same as for

the rest of ESA data (available free of charge to registered users) and MERIS data could also be distributed to ESA- approved investigators through NOAA CoastWatch website.

5.6 KORDI: Geostationary GOCI mission

Yu-Hwan Ahn reported on the pre-launch status of GOCI on the COMS-1 satellite. A number of issues related to radiometric calibration had been addressed, and a requirement of 0.01% had been confirmed by test results. An accuracy requirement of less than 3.8% had been achieved (solar calibration only). The GOCI instrument was shipped to Korea in November 2008, and had been successfully integrated into the COMS satellite in KARI, where a final ground test campaign was on going. The launch from the Kourou Space Center, French Guiana, was scheduled for November 2009, or more likely the beginning of 2010.

The Korea Ocean Satellite Centre (KOSC) of KORDI had the intellectual property rights to GOCI data, as well as distribution rights. KOSC was responsible for mission scheduling, receiving and archiving satellite data, providing standard data processing services and sensor optical calibration, while the Satellite Operation Center (SOC) of KARI was responsible for the operation of the satellite including ground control, orbit determination etc. For domestic users, GOCI-1 L1B/L2 data would be distributed free of charge to the public and researchers, who would have priority over commercial users. Data access would be via online distribution in near real time (within 2 hours). For foreign users, GOCI-1 data would be distributed free of charge to registered PIs for research purposes, in delayed mode (within 1-3 days) to avoid line traffic. Redistribution was not authorized except under a special contract with KOSC/KORDI. It might be possible to set up direct receiving stations, with a mutual agreement between two countries.

Plans for GOCI-2 were on going and would succeed and expand the GOCI-1 mission. The new mission would establish an ocean observation system to monitor long-term climate changes with full disk observation, and would monitor the environment for the efficient management of coastal waters with high resolution (250 m). Key user requirements would be 13 spectral bands (up from 8), spatial resolution of 250 m and 1 km (up from 500 m) and a temporal resolution of 1 h and 12-24 h, with night time observation for observation of fishing ships. KORDI welcomed suggestions for band changes for GOCI-2 from the IOCCG.

ACTION 14/7: IOCCG COMMITTEE MEMBERS TO PROVIDE SUGGESTIONS FOR BAND CHANGES FOR GOCI-2.

5.7 CNES: Activities contributing to the OCR-VC Implementation Plan

Eric Thouvenot reported that CNES was actively contributing to most of the objectives of the OCR-VC implementation strategy and plan. Contribution to OCR continuity was being accomplished through the ongoing Parasol mission, research and development activities, as well as a feasibility study on a geostationary mission. The Parasol mission (carrying the POLDER sensor) was designed to operate for 1-2 yrs, but was still working well after more than 4 years. It was not initially planned for ocean colour use, but CNES made a decision to do so after the loss of ADEOS-2. Comparisons with MODIS revealed that the data was qualitatively acceptable, with known limits. One of the main concerns after launch was the problem with the 443-nm channel, which had been lost for ocean colour. CNES was a research and development

agency and had undertaken many ocean-colour related activities at various levels, including development of state-of-the-art instruments (*e.g.* MERIS, GOCI, OLCI and Hyperspectral sensors) as well as feasibility studies for ocean-colour missions in geostationary orbit. Added value of GEO observations included a very short access delay, cloud removal and capacity to track the evolution of fast-changing events (pollution, red tides). There was a trade off between geostationary and geosynchronous orbits (30^o inclination).

CNES was also contributing to high-quality data sets by performing a number of vicarious calibration activities, including funding the BOUSSOLE buoy, SIMBADA radiometers, gliders and BIO-Argo floats. Research and development activities included adaptation of radiative transfer codes, algorithms for atmospheric correction and bio-optical algorithms for coastal waters. CNES also contributes to data assimilation and forecasting for Mercator-Ocean. In conclusion CNES was ready to contribute to the tasks of the OCR-VC group to promote ocean colour missions and activities. In particular, CNES would recommend using this group to define a strategic plan for observation of the oceans from a geostationary orbit.

5.8 JAXA: Phase 1 development of G-COM C and S-GLI instrument

Hiroshi Murakami reported on the Phase-1 development of the GCOM-C satellite, one of JAXA's earth observation missions for global environmental observation which would carry the SGLI instrument. GCOM-C targets included monitoring radiation budget changes and global environmental change including the carbon cycle, and reducing the uncertainty in global warming estimates. The mission would also contribute to operational uses such as fishery estimation and prediction and catch management.

The GCOM-C satellite series would provide more than 10 years of observations from 3 satellites, each operating for 5 years, with a one-year overlap (GCOM-C1, C2 and C3). The launch date was still under discussion, but most likely the end of 2013 or early 2014. A GCOM-C1 research announcement was released in Jan-March 2009 and proposals were currently under evaluation. This phase would include the initial development of new algorithms and improving the theoretical accuracy. SGLI features included a finer spatial resolution (250 m and 500 m), 11 visible channels as well as two multi-angle channels at 670 and 865 nm to improve land, coastal, and aerosol observations. International collaboration with NOAA/NPOESS and discussions with NASA, ESA and CNES regarding science and applications, with possible data merging with other sensors in a few years, had been undertaken. The GCOM-C concept harmonizes with the CEOS/OCR-VC as well as the CEOS/WGCV/IVOS concept.

5.9 ISRO: OCM-II on Oceansat-2

Rangnath Navalgund and Srinivas Kumar were unable to attend the meeting, but Dr. Navalgund had informed the Committee that there had been some delay in the launch of Oceansat-2, which was now likely to be launched some time in June/July 2009.

5.10 INPE: Argentine-Brazilian SABIA/mar mission

Milton Kampel reported on the Argentine-Brazilian SABIA/mar mission. Presidents from both countries had approved the joint development of a remote sensing satellite, and they also requested financial authorities to identify sources of funding for this project. The satellite

would target a number of applications (oceanography, sustainability of marine living resources, fisheries, environmental and coastal management, hazards etc.) with daily observation at 1-km spatial resolution, using 12-13 bands in the visible. Brazil would provide the payload, Argentina would provide the platform, and both countries would be responsible for development of applications and the ground segment. There would be an open data policy. The satellite could accommodate two sensors: a global instrument plus one for more regional applications. The specifications would be completed soon. There were plans for another workshop in Brazil for wider consultation with both the scientific and engineering end-user communities. Mission specifications would be completed this year, and funding would be requested. Instrument design was still under discussion and it had not been decided whether there would be international collaboration or local development. Paula Bontempi stated that if there was an Announcement of Opportunity for instrument design, NASA would most likely respond.

5.11 EUMETSAT's Role in Ocean Missions

The Chairman reported on EUMETSAT's contribution to the OCR-VC on behalf of Hans Bonekamp who was unable to attend the meeting. EUMETSAT's mission was to deliver operational satellite data and products that satisfy the meteorological and climate data requirements of the 24 EU member states and 6 cooperating states. EUMETSAT would be responsible for the operation of the Sentinel-3A and -B satellites including the command and control of the satellites, the payload data processing (marine component) and dissemination of the marine products to the user community through EUMETSAT Data Dissemination Systems (EUMETCast, EUMETSAT EO portal). EUMETSAT also had third party cooperation agreements to secure data from NOAA (POES, NPP and NPOEES), China (CMA HY-2) and India (ISRO SARAL, Oceansat-2 and -3) and were also involved in a number of other CEOS virtual constellations (Ocean Surface Topography and Ocean Surface Winds). The Chairman warmly welcomed EUMETSAT into the group and remarked that he was pleased that they were interested in contributing to the OCR-VC.

5.12 JRC: Contributions to the OCR-VC

Nicolas Hoepffner gave a brief overview of ChloroGIN: a network of networks established to promote *in situ* measurements of chlorophyll in combination with satellite-derived estimates and associated products. ChloroGIN was an explicit task under the GEO Ecosystem SBA (Societal Benefit Area), with a number of implicit links to other SBAs. ChloroGIN facilitates dissemination of satellite data and advanced products through dedicated web portals, improved connections between networks and receiving stations, with links to the EU project DevCoCast. ChloroGIN also reviewed protocols for *in situ* measurements and had a strong component in capacity building. New members were encouraged to be part of network and he noted that it would be very beneficial to have SIO as part of the network (ChloroGIN China). ChloroGIN had been selected as one of the demonstration projects for the EU DevCoCast initiative which uses the GEONETCast concept to provide processed land and ocean satellite data and value-added products to developing countries. A training session on the GEONETCast data dissemination system would be held at the IGARSS meeting in Cape Town (13-17 July 2009).

Dr. Hoepffner also reported on GMES (Global Monitoring for Environment and Security), a European initiative for the implementation of information services dealing with environment and security, incorporating *in situ* systems, space systems and data integration and information

management. GMES was now in its implementation phase: MyOcean was the implementation project of the GMES Marine Core Service. The project consisted of 7 Monitoring and Forecasting Centers (MFC) and 6 Thematic Assembly Centers (TAC). The objectives of the ocean colour TAC was to build and operate a European Ocean-Colour Service for GMES marine applications. The EU was committed to supporting capacity building efforts in Africa and recently started GMES Africa to improve long-term use of EO in management of natural resources in Africa (duration 2010-2018). JRC was also responsible for science and data requirements for GCOS ECVs, including assessing uncertainties of individual ECVs used in the calculation of primary production. A workshop would be held at JRC from 3-5 June 2009 with a theme of biosphere primary production. Another JRC initiative was an ocean-colour training course to be held in Zanzibar (Tanzania) from12-23 October 2009, in partnership with a number of other organisations, including support from the IOCCG.

5.13 OCR-VC Implementation Plan and way forward

The Chairman highlighted some of the agency activities from the previous presentations that could contribute towards the Phase 1 Draft OCR-VC Implementation Plan, which would cover the period 2008 through to the launch of Sentinel-3 (late 2012).

Objective 1: Ensuring OCR Continuity

- Improvements to VIIRS on NPOESS C1: currently trying to mitigate cross-talk issues with improved filter and better spectral out of band characterization for VIIRS on NPOESS C-1 platform (scheduled for launch in late 2012).
- NASA was initiating the first end-to-end reprocessing of ocean-colour data, including OCTS and CZCS.
- Several agencies were evaluating geostationary or geosynchronous orbits for OCR sensors. In addition, an IOCCG Working Group was evaluating user requirements as well as new capabilities for OCR measurements from geostationary platforms. Some sort of inter-agency coordination of coverage was highly desirable. Perhaps CNES could host a workshop to discuss these issues.
- NASA would include ISRO OCM-2 data processing capability in SeaDAS.
- Pre-launch cooperative activities for Sentinel-3A and -B were approved.
- Brazil and Argentina would launch a two-sensor OCR mission with instruments for both global and regional coastal coverage. Mission specifications would be completed in late 2009.

Objective 2: Providing High Quality Data Sets

- NOAA would continue support for the MOBY optical buoy. MOBY-continuation (MOBY-C) would ensure continuity of vicarious calibration across past, present and future ocean color sensors, and should be in the water before the end of 2011.
- The SeaWiFS HPLC round-robin experiment would improve the quality of HPLC phytoplankton pigments for the SeaBASS archive, and would also establish new HPLC measurement protocols.
- Continued interactions between NASA and ESA related to MERIS calibration and characterization, and extended to pre-launch Sentinel-3 activities.
- MERIS would be reprocessed for the third time by December 2009 using the same vicarious adjustment approach as used by NASA for SeaWiFS.

- MERMAID, a centralized data base of *in situ* bio-optical data measurements plus concurrent MERIS extractions, would be one of the tools for validating the next MERIS reprocessing. NOMAD data had been incorporated into MERMAID, as well as ocean colour AERONET data (a ground validation network for the aerosol community) via a cross ESA/NASA agreement (AERONET could be inserted into the IP as a separate item funded by NASA).
- ChloroGIN promotes *in situ* measurement of chlorophyll in combination with satellite-derived estimates. China expressed an interest in establishing a network for Chinese regional waters (contact Xianqiang He of SOED/SIO/SOA).
- André Morel pointed out that the NOMAD database was strongly biased towards coastal waters, and he recommended a balance between coastal and open ocean waters for match-ups. Also, no data for CDOM was available for open-ocean, oligotrophic waters because of spectrophotometric limitations (no CDOM data for ~80% of ocean). He suggested that a recommendation be made to use new techniques for measuring CDOM, even if they were very complicated.

Objective 3: Data Harmonization

- ESA's GlobColour project demonstrated the benefits of a multi-sensor data merger as an important step towards an ocean-colour Essential Climate Variable (ECV) for global products. GlobColour products would continue as part of the EC GMES Marine Core Service *i.e*. MyOcean
- ESA is currently planning the CoastColour Project for several coastal study areas using MERIS 300-m data. "Champion Users" would be selected by Q4 2009.
- MERIS Quality WG includes members from SeaWiFS and MODIS teams. The next meeting was scheduled for 27-29 April 2009 at ESRIN, and meetings would continue in the future.
- The IOCCG BIO-Argo working group was evaluating requirements and applications for bio-optical sensors on Argo floats. A pilot study was under consideration, which NASA had agreed to fund.

Objective 4: Facilitate Timely and Easy Access to Data (User Interface)

- CSA was upgrading ground infrastructure at the Canada Centre for Remote Sensing (CCRS) for the reception and processing of full resolution (300 m) MERIS data. Coverage included most of the Canadian Arctic, Pacific and Atlantic coasts. Beginning in Q4 2009, data would be processed in Canada rather than in Europe. Access was available to Canadian Government users or to ESA-approved users from any country.
- Starting in Q4 2009, INPE would acquire, process and distribute MERIS full resolution data for South American waters.
- VIIRS NPP data, and possibly data from other international sensors, would be incorporated into NOAA's OceanWatch portal for operations and climate applications.

Objective 5: Capacity Building and Outreach

- Support GEO Coastal Zone Community of Practice (CZCP)
- Include INPE ocean-colour training course, sponsored by POGO and the Nippon Foundation (Rio de Janeiro, October 2009)

- Include IOCCG report on "*Partition of the Ocean into Ecological Provinces*", as a contribution to the GEO Ecosystems SBA.
- Include GeoNetCast / DevCoCast (text to be provided by Stewart Bernard)

The next SIT meeting would take place from 10-11 September 2009 in Darmstadt, Germany. Nicolas Hoepffner agreed to attend the meeting as the OCR-VC Co-Chair. A final draft of the implementation plan would be submitted before the meeting. Dr. Hoepffner suggested that the document should be structured with deliverables and timelines, and that omissions should be highlighted to encourage one of the agencies to take responsibility.

6.0 Capacity Building

6.1 Training Course on Inversion Procedures in Ocean Colour Remote Sensing

Roland Doerffer informed the Committee about an advanced training course on inversion procedures which he was organising with support from GKSS. The course would take place in Lauenburg / Hamburg from 10-14 August 2009, and would provide an overview of inversion methods and models, as well as uncertainty analysis of ocean-colour remote sensing data. Datasets would be analysed and a number of different inversion techniques examined. The course could accommodate 15 scientists/graduate students who were working with ocean colour data in complex waters, and who had a strong mathematical background. Lecturers would include Zhongping Lee, Mark Dowell, Stewart Bernard, Andreas Neumann, and Roland Doerffer.

The course would be sponsored by GKSS (€10,000), the "Friends of GKSS" organisation (€2,000 Euros) and JRC (€5,000 Euros), with no cost to the IOCCG. This would cover travel expenses for the lecturers, social events, plus travel support for about 8 participants. Initially it was proposed to include a separate workshop on errors and uncertainties, but there was not enough time. Dr. Doerffer proposed a new IOCCG working group address this topic as it was very important in coastal waters. The WG could provide a review of present techniques to determine uncertainties, estimate typical errors and uncertainty ranges for different types of waters, perform sensitivity studies, set up and test procedures to determine errors and uncertainties on a pixel by pixel basis, flag data which are out of scope and examine how best to present errors / uncertainties in data products. Stewart Bernard also suggested that error analysis could be included in the proposed Regional Algorithm WG.

6.2 JRC Training course in Tanzania

Nicolas Hoepffner provided information on the JRC-organised training course on *Methods and Applications of Ocean Colour Remote Sensing in Coastal and Regional Seas*, which would take place in Zanzibar, Tanzania from 12-23 October 2009. The course would be hosted by the Institute of Marine Sciences, University of Dar-es-Salaam with support from a number of partners including the IOCCG, which would allow fellowships to be provided to all participants. About 20 participants from east Africa and west Indian Ocean islands could be accommodated. The structure of course would be similar to that in Mombassa, with lectures in the morning, and afternoon practical sessions, and would include training on various image processing software packages (BEAM and SeaDAS). The second week of the practical session would take the form of mini-projects.

6.3 Ocean-colour remote sensing entry for Wikipedia

Prior to the meeting, Mark Dowell had submitted the proposed initial content for an "Ocean Colour" Wikipedia entry. It was not intended to be exhaustive, but rather something that could be added to in time. He suggested placing the entry in a temporary "sand-box area" on the web for people to take a look. There was an existing entry for CZCS that also referred to ocean colour. IOCCG members were requested to provide feedback and Paula Bontempi noted that NASA Goddard would edit the entry once it had been posted. She also suggested that Mark send the entry to Jim Acker and Gene Feldman for comment.

ACTION 14/8: MARK DOWEL TO POST OCEAN COLOUR ENTRY IN THE WIKIPEDIA "SAND-BOX" AREA, AND ALSO SEND THE TEXT TO JIM ACKER AND GENE FELDMAN FOR COMMENT.

ACTION 14/9: IOCCG MEMBERS TO PROVIDE FEEDBACK ON OCEAN COLOUR WIKIPEDIA ENTRY TO MARK DOWELL.

7.0 Any Other Business

7.1 Review of IOCCG's proposal to NASA for funding

Paula Bontempi summarised the reviews of IOCCG's proposal to NASA for sponsorship, and presented some community suggestions for the future. Overall the reviews were very complementary. There was one question relating to the international coordination of ocean-colour missions – how was the IOCCG handling free and open access of data distribution. This theme had been raised several times by the research community. There was also some concern that the IOCCG had not been effective in conveying the importance of ocean colour as a critical parameter in Earth observation. Reviews were extremely complementary about IOCCG's capacity building efforts with developing countries.

It was noted that there was a heavy bias in the composition of Committee Membership toward North America (USA and Canada); central and South America were also important and there was no representation from countries such as Argentina that also had a space agency. The value of IOCCG publications was queried, especially since they were not published through peer-reviewed journals, and there was a perception that working groups led by current or past IOCCG Committee Members had limited impact. It was recommended that the IOCCG consider publishing articles in peer-reviewed journals as well. There were also comments about holding WG meetings in remote places (cost implications). Lastly it was noted that IOCCG was one of the few mechanisms that could help developing groups survive until actual resources are provided via a framework such as GEOSS.

The Chairman noted that it was difficult to publish IOCCG material in journals as the authors would not be listed as IOCCG. Paula Bontempi suggested publishing a short article in EOS to summarise the highlights. Trevor Platt pointed out one advantage of publishing under IOCCG was that the copy right was retained, and that the material could be distributed free of charge. The Chairman suggested adding IOCCG as an author for the OceanObs'09 White Paper, and perhaps publishing a short article on the OCR-VC in EOS or New Scientist. Stewart Bernard suggested that working groups could publish short papers in a journal that referred back to the IOCCG report.

ACTION 14/10: JIM YODER TO SUBMIT A SHORT ARTICLE ON THE OCR-VC FOR PUBLICATION IN EOS OR NEW SCIENTIST.

Shubha Sathyendranath also noted that in certain circles the IOCCG reports were very successful, especially for capacity building. A scientific journal might not be the right target to reach a broader audience, but perhaps something like Scientific American or Sunday papers. The IOCCG could also consider hiring a PR person for outreach to a larger audience, but it would cost money. Stewart Bernard suggested that the IOCCG should interface more with biogeochemical modellers. The Chairman pointed out that Siegel *et al*. had made an effort to generate visibility for ocean colour in the IPCC assessments, and they were now thinking about an entire oceans chapter. Paula Bontempi agreed to talk to Gene Feldman about updating the Air and Space Museum exhibit on ocean colour, to help the public recognise that climate change is not just CO_2 and sea level rise, but that biogeochemistry is also very important.

Trevor Platt queried whether IOCCG Report 7 was available at the time of the review, as the report was specifically written to convey the importance of ocean colour as a critical parameter in Earth observation. Paul DiGiacomo also proposed a variety of other ways to communicate IOCCG's perspective *i.e.* short 2-page thematic papers on the web, on subjects such as ocean colour and climate, fisheries, water quality etc. Paula Bontempi reiterated that free and open access to data was very important and perhaps IOCCG should consider hosting a small meeting to address this topic. The Chairman noted that each agency would have to bring the right people to the meeting. After the meeting GEO announced the formation of a GEOSS Data Sharing Task Force, with the objective of developing implementation of the GEOSS Data Sharing Principles to achieve the full and open exchange of data, metadata and products at minimal cost and delay (first meeting 27-28 May 2009, in Geneva).

7.2 Hyperspectral Imager for the Coastal Ocean (HICO)

Curtiss Davis gave a brief overview of the HICO instrument, to be mounted on the Japanese Experiment Module of the International Space Station (launch date 14 September 2009). The instrument had been developed and sponsored by the Office of Naval Research and the Space Test Program and was built in 15 months, at low cost. HICO lab characterization and calibration and modelled signal-to-noise ratio met requirements nicely. There will be a maximum of one observation (scene) per orbit (50 x 200 km, 100 m Ground Sample Distance, 5.7 nm spectral bins). HICO is designed to demonstrate the utility of maritime hyperspectral observations from space. The sensor has been delivered and current efforts are focused on having a HICO data system and science team in place and fully functional before September 2009 to process and make best use of HICO data. Funding is available for one year of operations, which might be extended if additional funding was obtained. The primary customer is the operational navy but additional data is available for scientific research. HICO data will be a full spectral image cube and will also produce products that resemble MODIS data, but with 100 m ground resolution. Oregon Sate University would host the data for the international community and there was a short list of users whose sites would be imaged. There are plans for a follow-on sensor that would provide higher resolution data, but currently no sponsor.

7.3 Issues arising from IOCCG-14 meeting

BIO-Argo: Three floats were proposed by the WG - were any of these outside of IOCCG's remit? The Chairman noted that shallow floats would be outside the typical Argo mission cycle, but they could still be part of the Argo array. Shubha Sathyendranath suggested that the report should take broadest possible perspective, and include all the options. Stewart Bernard noted that it would depend on the pilot project and the individual researchers who would buy the floats. The BIO-Argo float was probably the best to fulfil the vision of creating a biogeochemical global observation system. The Chairman pointed out that the real impact was not to validate ocean-colour data, but to obtain biogeochemical data with depth. The next step would be a pilot study. Paula Bontempi suggested that ONR might be interested in the pilot study, which could be controlled and run through the IOCCG, with outside input. NASA would sit down with the interested parties to scope out a pilot study.

GO-SHIP: Shubha Sathyendranath drew attention to the fact that no structured mechanism was in place to respond to opportunities for observations from *in situ* platforms. A related issue was how to carry out these measurements. Should a committee be established to look into it these issues on a routine basis? Curtiss Davis queried the value of this type of data, which was only collected every 10 years. Dr. Sathyendranath pointed out that this was routine, sustained, repeat observations over decades, in un-sampled and under-sampled regions of the ocean, and could provide information on ecosystem changes over a long time scale. Paula Bontempi noted that NASA had invested in programmes such as this, and could entertain the possibility of supporting a proposal under the auspices of IOCCG. The value to the satellite community would be validation, but the user community should be broader, and include modellers. Paul DiGiacomo noted that the data would be invaluable for biogeochemical programmes such as SOLAS and IMBER etc. and that it was important to come up with a consolidated approach, perhaps via the climate observing programme of NOAA.

The Chairman queried whether the IOCCG was the right group to be thinking about a 3D working group? Paul DiGiacomo replied that it was important to provide leadership and that there were different elements within the Committee to push this to a higher level as a community, on a global scale. The consensus was that a few Committee members would discuss this further offline.

GCOS Representation: It was agreed that the ocean-colour community should get better representation with GCOS. Jim Yoder and would discuss this further offline.

8.0 Organisation and Membership

8.1 Rotation of Committee members

Pan Delu (SIO, China), Srinivas Kumar (INCOIS, India) and Heidi Sosik (WHOI, USA) were stepping down at the end of the meeting, and would be replaced by Tasuku Tanaka (Yamaguchi University, Japan) and Zhihua Mao (SIO, China).

8.2 Plans for IOCCG-15 Committee meeting

Milton Kampel announced that INPE was pleased to host the next IOCCG Committee meeting in Brazil. The meeting would take place in a hotel in Rio de Janeiro from 18-20 January 2010.

8.3 Invitation to host 2011 Committee meeting

Tasuku Tanaka informed the Committee that he was currently acting director for the Center for Remote Sensing and Ocean Science (CReSOS) at Udayana University, Bali, Indonesia, and would become Director in March 2011. CReSOS runs a Masters post-graduate programme through which the students have acquired sufficient capability to analyse satellite data. An Indonesian Ocean Data Archive was being established for satellite ocean data to study climate change, fisheries applications, environment etc. Archived data would be disseminated through the Internet to the rest of the world. CreSOS represented a national node for remote sensing and ocean science and an international node for climate research. Dr. Tanaka invited IOCCG to hold their 16th Committee meeting in Indonesia, and suggested the best time would be June to August. This would be discussed at the Executive meeting.

8.4 Closing Comments

The Chairman thanked the hosts again for their wonderful hospitality, and wished everyone a safe journey home.

Appendix I: LIST OF PARTICIPANTS

14th IOCCG Meeting, Hangzhou, China

20-22 April 2009

IOCCG Members	Affiliation
Ahn, Yu-Hwan	KORDI, Korea
Antoine, David	LOV, Villefranche, France
Bernard, Stewart	CSIR, South Africa
Bontempi, Paula	NASA HQ, USA
Davis, Curtiss	Oregon State University, USA
DiGiacomo, Paul	NOAA, USA
Doerffer, Roland	GKSS, Germany
Dowell, Mark	JRC, Italy
Hoepffner, Nicholas	JRC, Italy
Kampel, Milton	INPE, Brazil
Lavender, Samantha	University of Plymouth, UK
Murakami, Hiroshi	JAXA/EORC, Japan
Pan, Delu	Second Institute of Oceanography (SIO), China
Platt, Trevor (Past Chair)	POGO Executive Director, UK
Regner, Peter	ESA/ESRIN, Italy
Sosik, Heidi	Woods Hole Oceanographic Institution, USA
Tanaka, Tasuku	Yamaguchi University, Japan
Thouvenot, Eric	CNES, France
Yoder, James (Chair)	Woods Hole Oceanographic Institution, USA

Invited Participants	Affiliation
Helbig, James	Department of Fisheries and Oceans, Canada
Lee, ZhongPing	Mississippi State University, USA
Morel, André	LOV, Villefranche, France
Sathyendranath, Shubha	PML, UK
Stuart, Venetia	IOCCG Project Office, BIO, Canada
Wang, Menghua	NOAA/NESDIS/STAR, USA
Bai, Yan	Second Institute of Oceanography (SIO), China
Zhai, Li	Bedford Institute of Oceanography, Canada
Zhihua, Mao	Second Institute of Oceanography (SIO), China

Apologies	Affiliation
Bonekamp, Hans	EUMETSAT, EU
Claustre, Herve	LOV, Villefranche, France
Crevier, Yves	CSA, Canada
Frouin, Robert	Scripps Institution of Oceanography, USA
Kumar, Srinivasa	INCOIS, India
Medico, Ana	CONAE, Argentina
Navalgund, Ranganath	ISRO, India
Varotto, Conrado	CONAE, Argentina
Weeks, Scarla	University of Queensland, Australia