

**Sixth IOCCG Committee Meeting
La Jolla, California, 24-26 January, 2001**

MINUTES

The meeting took place at the Scripps Institution of Oceanography in La Jolla, California. Fourteen Committee members were present plus several invited participants (see attached list of participants).

1. Welcome Address and Logistics

The Chairman, Dr. Trevor Platt, welcomed all participants and thanked them for traveling to California to attend the meeting. He also thanked Dr. Robert Frouin for agreeing to host the meeting at Scripps and for his efficient planning and organization. Congratulations were extended to Prof. André Morel for receiving the first Jerlov Award in recognition of his outstanding achievements in ocean optics.

2. Adoption of the Agenda

The circulated agenda was adopted as stands.

3. Approval of Minutes of 5th Committee Meeting

The minutes were approved with the following change proposed by Dr. Mervyn Lynch: Item 5a, last line, should read "A proposal will be submitted to SIMBIOS to foster further international intercomparisons.

4. Matters Arising from the Minutes of the 5th Committee Meeting

a) Definition of "normalized water-leaving radiance"

Prof. André Morel distributed detailed documents reviewing the basic equations for normalized water-leaving radiance, $[L_w]_N$, and pointed out that differences exist between the definitions for satellite $[L_w]_N$, exact $[L_w]_N$, and *in-situ* $[L_w]_N$. These radiances were not directly comparable, despite normalization, since they depended on the pixel-sun geometry. He noted, however, that it was possible to make reversible transformations from one to another to correct for the bi-directional effects. It is important to have a robust measure of normalized water-leaving radiances in order to generate meaningful Level-3 products.

The Committee recommended that all Agencies provide two products: the conventional normalized water-leaving radiances, as well as a product corrected for bi-directional effects (using the same look-up tables).

ACTION 6/1: PROF. MOREL TO DRAFT A LETTER TO AGENCIES (COPY TO SIMBIOS) REQUESTING THAT $[L_w]_N$ DATA ARE CORRECTED FOR BI-DIRECTIONAL EFFECTS (ATTACH APPENDIX WITH EQUATIONS).

ACTION 6/2: PROJECT OFFICE TO MAIL $[L_w]_N$ LETTER TO ADDRESSEES PROPOSED BY COMMITTEE MEMBERS.

b) *CEOS/WMO database*

Dr. Jim Yoder reported that he had submitted the IOCCG observational requirements (as discussed at the IOCCG Committee meeting in Hobart) to the CEOS/WMO database and had received a number of queries regarding units and accuracies, which seemed to be based on lack of understanding. Dr. Yoder had compiled a new list incorporating accuracy values for each wavelength, which was circulated to the Committee for comment. Once approved, the list would be resubmitted.

ACTION 6/3: DR. YODER TO PROVIDE A NEW LIST OF IOCCG OBSERVATIONAL REQUIREMENTS FOR CEOS/WMO DATABASE.

c) *IOCCG Report No. 3*

Report Number 3 was published last November (2,000 copies printed) and had been very well received by the scientific community. Prof. André Morel proposed that the Committee extend congratulations to the editor of the report, Dr. Shubha Sathyendranath, for doing such an excellent job.

d) *Monographs on Ocean-Colour Studies*

Dr. Frouin noted that he had had too many other commitments in the past year to work on this activity and that it might be preferable to find another leader. He suggested that an editorial committee be formed.

e) *Ocean-colour module for BILKO*

Dr. Frank Shillington had contacted Dr. Craig Donlon, who suggested that ocean-colour lessons would fit into a BILKO module entitled “Vulnerability through the eye of a satellite”. Dr. Shillington suggested that the best way to develop these lessons would be as part of part of a training course to be held in Cape Town (see agenda item 13c).

f) *Continuity of SeaWiFS data*

In March, 2000, the Chairman wrote a letter to Dr. Ghassem Asrar pointing out the value of continuity in the SeaWiFS mission. Dr. John Marra noted that there were budgetary concerns at NASA regarding extension of the SeaWiFS data buy from Orbimage, but a proposal for an extension from 2003 to 2008 had been inserted into the FY03 budget process. There were many compelling reasons to promote continuation of the SeaWiFS data buy, including the use of SeaWiFS data to calculate global productivity on land and sea (article to come out in imminent issue of Science). Furthermore, the instrument itself was performing better than specifications (for radiances); SeaWiFS data is being widely used by over 1500 registered users worldwide (there are 102 ground-stations around the world); and there is a requirement in NASA’s earth science implementation plan for systematic (operational) ocean-colour observations. However, in NASA’s view, the NPOES mission is scheduled to take over ocean-colour observations in 2002.

5. Current IOCCG Working Groups

a) Calibration of Ocean-Colour Sensors

▪ *Calibration Working Group*

Dr. Frouin summarized the activities of the Calibration Working Group since the previous IOCCG meeting. Initially it was agreed that there would be one report, which would include both pre-and post-launch calibration. Dr. Frouin proposed that there should now be two reports (a separate pre- and post-launch report) and he agreed to take the lead on the post-launch report. Dr. Michael Rast noted that the outline for the report was good, but that there was not much material for a pre-launch calibration report. The Committee recommended that it would be best to have the pre-and post launch material under one cover.

Dr. Frouin agreed to take responsibility for the production of this report, based on the current outline. Dr. Rast promised support and would contact Dr. Andreas Neumann. Dr. Menghua Wang suggested that the word “absolute” be removed from the proposed title of the report, which should read “Calibration of Ocean-Colour Sensors to Common Standards”.

▪ *Cal/val for GLI*

Dr. Ichio Asanuma presented a summary of the calibration and validation strategy for GLI on ADEOS-II, which is scheduled to be launched in February 2002. Post launch calibration will include relative calibration (solar and internal lamp calibration), absolute calibration (synchronized observations with SeaWiFS, MODIS), vicarious calibration (*in situ* measurements from mooring buoys off Ishigaki Island) as well as ocean validation through field campaigns in the East China Sea (atmospheric correction, bio-optical parameters, sea-surface temperature). It was anticipated that the operational phase of GLI would start approximately 12 months after launch.

▪ *MERIS cal/val and liaison with CEOS WGCV*

Dr. Michael Rast gave a brief presentation on the calibration of MERIS, which was scheduled for launch in July 2001, onboard Ariane-5. MERIS would employ an onboard calibration principle with a calibration wheel. It has two spectralon diffusers, one of which will be used to monitor diffuser aging characteristics. Absolute radiometric calibration of the sensor was performed in 1996 and 2000; cross-calibrations with NASA agreed to within 0.5%.

Dr. Peter Regner briefed the Committee on the validation concept of MERIS. Cal/val objectives for commissioning phase (first 6 months) would include full in-flight calibration and re-characterization of the instrument, complete verification of Level-1b and Level-2 processing (algorithm verification), preliminary validation of geophysical products and tuning of processing parameters. The MERIS validation approach was based on projects proposed by the scientific community in response to an Announcement of Opportunity and would involve fixed moorings, ship measurement

campaigns, satellite intercomparisons and aircraft campaigns. Validation teams would take part in intercalibration of radiometric instruments, and intervalidation of measurement methods. Measurement protocols would be based on Ocean Optics Protocols (Revision 2), tailored to MERIS. Data from the validation campaigns would be held in a central data repository at the Norwegian Institute for Air Research (NILU).

b) Coordination of Merged Data-Sets

Dr. Nicolas Hoepffner conveyed apologies from Dr. Peter Schlittenhardt who was unable to attend the meeting. He reported on the data-merging working group, which was established last year in collaboration with Drs. Tasuku Tanaka and Janet Campbell. Their objective was to develop a procedure to be used by agencies to merge data. One of the first goals was to ensure that agencies archive similar data. The working group proposed to deal with two types of data: 1) the diagnostic data set and 2) Level-3 binned data. It was agreed that all coordinators would apply for their own funding and develop links within their own agencies. Dr. Campbell had submitted a proposal to SIMBIOS for funding while Dr. Schlittenhardt submitted one to the EC under the key area of global change. The proposed project would be coordinated by the JRC, and would involve seven other European partners (CNES, DLR, JKSS, LPCM, Southampton Oceanography Center, University of Aston and Institute of Oceanology, Polish Academy of Science). Unfortunately the proposal was rejected due to budget constraints, although it had passed all scientific reviews. Dr. Campbell's proposal was also not funded. Nevertheless, JRC was still keen to continue their efforts with merged data sets once they knew what other groups were doing. According to Dr. Marra, NASA would like to promote data merging activities through the SIMBIOS Project, using diagnostic data sets from various sensors, and also through inverse modeling. Dr. Hoepffner stressed that it was important to ensure that agencies collect the data for the diagnostic data sites.

Dr. Tanaka noted that NASDA's position on data merging was different. They were concentrating on how to maximize the use of the ADEOS data set by integrating new data (from TOMS etc.). NASDA had created the World Estuary data set using ADEOS data, which could be used as a test bed for developing Case 2 algorithms and would also promote coastal zone monitoring. NASDA encouraged proposals from other agencies to merge their data sets with the ADEOS data.

The Chairman enquired whether the IOCCG should carry on with the data-merging activity since two of the three national proposals were not funded. Dr. Frouin responded that the SIMBIOS Project had the tools and man-power to carry on with the data merging activity and that they would also be responsible for creating the diagnostic data set. Dr. Rast noted that ESA had already made provisions for the diagnostic data sites and that ESA was going to propose that processing of MERIS data be incorporated into the SeaDAS software.

Dr. Hoepffner stated that the JRC proposal could be resubmitted if the Committee thought it was a useful proposal and he questioned whether the SIMBIOS Project was in

contact with other Agencies to coordinate data-merging activities. Dr. Marra replied that 12 international groups were part of the SIMBIOS Project and that the IOCCG should discuss the diagnostic data sites. Dr. Hoepffner proposed that the IOCCG coordinate with NASA/SIMBIOS data-merging activities. Dr. Tanaka agreed to talk to Dr. Campbell, Dr. Schlittenhardt and SIMBIOS and report back to the IOCCG. It was agreed that the list of diagnostic data sites should be discussed in more detail at the upcoming SIMBIOS meeting.

ACTION 6/4: DR. TANAKA TO CLARIFY THE SITUATION REGARDING THE IOCCG DATA MERGING WORKING GROUP THROUGH CONSULTATION WITH DR. CAMPBELL, DR. SCHLITTENHARDT AND THE SIMBIOS PROJECT. KEEP PROJECT OFFICE INFORMED.

c) Comparison of Atmospheric Correction Algorithms

Dr. Wang presented a status report on the progress of the atmospheric correction working group. The main objective of the group was to quantify the performance of existing atmosphere correction algorithms used by various ocean-colour sensors. Derived products from various ocean-colour missions could then be meaningfully compared and possibly merged. The core working group (Morel, Antoine, Deschamps, Frouin, Fukushima, Gordon and Wang) would test the performance of atmospheric correction algorithms from SeaWiFS, POLDER-1/POLDER-2, OCTS/GLI, MERIS, and MODIS. These sensors have six bands in common (or close): 443, 490, 555, 670, 765 and 865 nm. The working group agreed to compare the derived normalized water-leaving reflectances for wavelengths at 443, 490 and 555/565 nm as well as two-band ratio values (443/555 and 490/555). Furthermore, the aerosol optical thickness at 865 nm would also be tested.

Test data sets would be generated from simulations with a Radiative Transfer Equation (RTE) model and would be complemented by data from SeaWiFS measurements. In addition, some sensitivity case studies would be run (*e.g.* quantitative estimation of atmospheric correction over Case 2 waters). Dr. Wang would produce the test data set (almost complete), and other members of the working group would be responsible for testing their atmospheric correction algorithms (two to three months). An IOCCG Report would then be produced (another two to three months). The group hoped to complete all tasks by the end of the year, although this was dependent on individual members.

Dr. Wang noted that it was important for the group to have the support of the various Agencies involved and that there were some concerns about resources (money and time). The Chairman informed Dr. Wang that the IOCCG could provide some funding for travel support. He thanked Dr. Wang for what he had already done and encouraged the group to continue with this worthwhile activity.

Dr. Wang then gave a brief presentation on comparisons of OCTS and POLDER data. The motivation for the study was to compare data collected from the same platform, using similar channels and consistent algorithms. The SeaBASS data base was used for

OCTS and POLDER match-up analysis and it was demonstrated that meaningful comparisons could be made using OCTS and POLDER data. Bias differences of derived results between sensors could be removed, but noise differences could not (dependent on the sensor characteristics). This comparison was effectively a case study for data-merging at Level-1B.

d) International Ocean-Colour Cruise

Dr. Frouin reported that he had contacted Dr. Lisa Shaffer with the idea of setting up a project office for the International Ocean-Colour Cruise at Scripps, but she had some reservations since Scripps was research orientated and the cruise had a large education component. In addition, Dr. Frouin had not received much support from funding agencies for such a big enterprise, so he suggested that the IOCCG try something on a smaller scale. He mentioned that it might be possible to get free ship time on cruises returning from Ushuaia in Argentina to Kaliningrad in Russia (November to March), organized through the P.P. Shirshov Institute of Oceanology. The principal objective would be education.

Elizabeth Gross mentioned that UNESCO might have money for capacity building and that POGO was developing an interest in capacity building and training. She suggested that a partnership between IOCCG and POGO might be useful. The Chairman remarked that one of the POGO elements was certainly training and that the IOCCG should not wait until the next meeting to see if the proposal was viable. The Chairman proposed that POGO be approached about putting this matter on the agenda for its next meeting (June, 2001). It was also recommended that Dr. Oleg Kopelevich investigate in more detail the costs involved for such a cruise.

Dr. Lynch mentioned that he had proposed a possible interaction with the Japan/Australia GLI validation cruise, but that this was no longer an option. Dr. Jim Aiken noted that the AMT-13 (September, 2001) and AMT-14 (September, 2002) cruises were secured for validation of MERIS data and that a move was afoot to conduct a one-month cruise in the Atlantic (possibly on Discovery) for ocean-colour validation.

ACTION 6/5: CHAIRMAN TO REQUEST THAT PROPOSED IOCCG TRAINING CRUISE BE PLACED ON AGENDA OF NEXT POGO MEETING.

ACTION 6/6: DR. KOPELEVICH TO INVESTIGATE COST OF PROPOSED OCEAN-COLOUR TRAINING CRUISE.

e) Standard Validation Data-Set

Dr. Yoder notified the Committee that links were now available on the IOCCG homepage to various *in situ* chlorophyll data-sets. There were some overlaps between the various archives and about a 10-year time lag between the time of data collection and storage in the database. Nevertheless, the data were extremely valuable for those trying to blend satellite data with *in situ* data.

Dr. Yoder briefly mentioned a study that coupled CZCS satellite data with *in situ* data. Some 70,000 *in situ* chlorophyll observations were blended with the CZCS chlorophyll data using the CRAM method. Striking differences were found between the blended products and the CZCS data alone. CZCS underestimated global chlorophyll by 8-35% with larger regional effects. If sufficient *in situ* data were available, monthly climatologies could be calculated.

f) “*Why Ocean Colour?*”

The Chairman noted that this initiative did not start as a working group. The idea was to produce an IOCCG Report to state the value of ocean-colour data for society. It was now decided to subsume the report under that to follow from a new working group proposed by Dr. Christopher Brown (agenda item 7b).

6. SIMBIOS and the IOCCG

Dr. Frouin presented an overview of SIMBIOS Programme, consisting of the SIMBIOS Science Team and the SIMBIOS Project Office. Goddard had recently been restructured: Dr. Chuck McClain was head of the office for Global Carbon Studies, the SeaWiFS Project was headed by Dr. Gene Feldman and the SIMBIOS Project by Dr. Giulietta Fargion. The project had a worldwide, ongoing, *in situ* optical and atmospheric data collection programme with a new team of PI's, including a significant number of international PI's. The project was currently focusing on data-product validation and calibration activities using data from SeaWiFS, MOS, OCTS, and POLDER. Instrument calibration was also of prime importance, with several calibration round-robins planned. SIMBIOS had been approached by NASDA to assist in the reprocessing of OCTS GAC data, and also by KARI to assist with the calibration of OSMI.

SIMBIOS planned to continue the development of diagnostic data sets as recommended by IOCCG. The SIMBIOS Project had also proposed two examples of end products from a data merger: i) A climatology of chl-*a* that blends *in situ* and satellite data (Level-2 or Level-3 data from SeaWiFS, OCTS, POLDER or CZCS), which could be updated regularly as more data became available, and ii) A set of products that blends data from several ocean-colour sensors flying at the same time *e.g.* SeaWiFS and MODIS. Products would be improved in quality because data from different sensors had been combined. The output would be a time series, not a climatology.

These two objectives were endorsed by the IOCCG Committee. Dr. Hoepffner enquired whether the data-merging activities would be done in cooperation with the Agencies. The Chairman recommended that there should be some collaboration between SIMBIOS, Dr. Campbell, Dr. Schlittenhardt and Dr. Tanaka. Dr. Frouin was tasked to convey this at the upcoming SIMBIOS meeting and report back to the IOCCG.

ACTION 6/7: DR. FROUIN TO REPORT BACK TO IOCCG REGARDING SIMBIOS/IOCCG DATA-MERGING ACTIVITIES.

7. Proposals for New IOCCG Working Groups

a) Development of a “common” Level-3 product to facilitate merging of Level-3 ocean-colour data from various sensors.

Dr. Morel noted that there were problems when trying to merge information from different sensors, because the grids were not always the same. He summarized the schemes used by various agencies with respect to spatial and temporal averaging/binning. The size of the tiles from different sensors was not always the same so it was difficult to combine maps without interpolation or extrapolation. The same was true of temporal averaging, with different sensors using different binning schemes.

Prof. Morel recommended that this problem be pointed out to the Agencies and that they be encouraged to discuss this matter and come to an agreement about averaging schemes. Secondly, he recommended that this problem be studied in more detail by an IOCCG working group. Dr. David Antoine was proposed as the leader of this working group, which could include Drs. Yoder, Campbell, Morel, Tanaka and Alain Podaire. Draft terms of reference for the working group were drawn up by Dr. Yoder as follows:

- i) Summarize time and space binning schemes and their products.
- ii) Summarize the rationale/reason for each different approach.
- iii) Assess the impact/consequences of having different schemes.
- iv) Recommend one or more approaches that each project should incorporate.

The output of the working group would be a report or technical memo, which would be reviewed by the Committee and placed on the IOCCG homepage. A letter would also have to be drafted for the Agencies.

ACTION 6/8: MOREL/YODER/ANTOINE TO DRAFT LETTER TO AGENCIES REGARDING SPACE AND TIME BINNING SCHEMES.

b) Operational ocean-colour working group

Dr. Christopher Brown proposed a new IOCCG working group to examine various aspects of operational ocean colour. The goals would be to promote the use of near real time ocean-colour products, to facilitate the exchange of ocean-colour applications, and to assist in the exchange of ideas and approaches among agencies that currently possess or will establish an operational ocean-colour mission. The group would examine issues such as the problems associated with NRT acquisition, processing, distribution and storage of ocean-colour data and products, the expansion of an operational ocean-colour user base, inter-agency differences in products, the role of operational vs. science providers of ocean colour, and the development of instruments and techniques for validating regional bio-optical algorithms.

The immediate objectives would be to establish membership and agenda, to host sessions at relevant national meetings on the use of operational ocean-colour data, and to proceed with the proposed monograph on ocean-colour studies (“Why ocean colour?” report). Dr. Brown offered to act as Chair and take the lead in creating the working

group. Dr. Asanuma gave an example of the use of operational ocean colour in terms of fisheries, which could be included in the report (optimal Skipjack fishing areas could be predicted using SeaWiFS chl-a imagery). The Committee recommended that the term “operational” be clearly defined. Dr. Ulloa pointed out that the Coastal Panel of GOOS had a strong recommendation to incorporate satellite ocean-colour data. The Chairman suggested that it would also be useful to justify applications for climate change. If the scope of the report could be enlarged to include the carbon cycle, then this report could be combined with the proposed “Why ocean colour” report. Elizabeth Gross suggested that the group also get in touch with Dr. Tom Malone, Chair of the new Coastal Ocean Observations Panel (COOP), of GOOS.

ACTION 6/9: DR. BROWN TO TAKE THE LEAD IN PREPARING AN AGENDA FOR THE OPERATIONAL OCEAN-COLOUR WORKING GROUP.

c) Standardizing the extraterrestrial solar flux spectrum

Dr. Jim Mueller noted that it was important for the ocean-colour community to adhere to a common extraterrestrial solar flux spectrum. Currently, the SeaWiFS Project used that of Neckle and Labs (1984), but there was some evidence that the newer spectrum published by Thuillier *et al.*, (1998) agreed more closely with the NIST spectral irradiance standards. Dr. Mueller suggested that the international ocean-colour community should reconsider the choice of a standard for extraterrestrial solar flux and proposed that the IOCCG establish a working group to examine this topic and assess the impact of changing the standard. Agencies should be encouraged to use the same spectrum to maintain consistency. Dr. Mueller agreed to lead this working group although he could not afford too much time on the project. Dr. Podaire noted that CNES might be able to participate by supplying data and providing technical assistance. Prof. Morel agreed to help liaise and get the group started.

ACTION 6/10: PROF. MOREL TO HELP DR. MUELLER SET UP A WORKING GROUP TO ASSESS THE IMPACT OF CHANGING THE STANDARD EXTRATERRESTRIAL SOLAR FLUX SPECTRUM.

8. Issues Related to the Project Office

a) The Chairman mentioned that Elizabeth Gross had formally retired from her position as Executive Director of SCOR, but had taken on the role of Finance Officer with SCOR. The new Executive Director of SCOR is Dr. Ed Urban.

b) A new Information Officer, Bart Hulshof, had been appointed at the Project Office on a part-time basis. Unfortunately he would be leaving in May this year for personal reasons, so the Project Office would be looking for a new person.

c) The IOCCG homepage, initially hosted by the JRC, had been moved to the Interland web server (in Georgia) to facilitate access to the server. IOCCG news and announcements are sent out using their list-server. The Committee was shown proposed changes to the IOCCG homepage, which were all approved.

d) The Chairman solicited the Committee's views on the utility of the IOCCG brochures. Dr. Rast enquired whether they were really necessary considering the informative homepage, but Dr. Ulloa stated that he found them very useful for students. He also suggested that more educational material be included in the inserts. Dr. Yoder pointed out that the SeaWiFS homepage had suitable educational material which could perhaps be used for the inserts. Dr. Aiken suggested that the brochures be made available through the IOCCG website. The Committee agreed that there was still a use for printed material and that the inserts be reprinted, including more educational material. Dr. Rast agreed to provide material for a MERIS insert and Dr. Podaire would enquire whether CNES was interested in providing material for an insert.

ACTION 6/11: DR. RAST TO PROVIDE MATERIAL FOR MERIS INSERT.

ACTION 6/12: DR. PODAIRE TO ENQUIRE WHETHER POLDER WERE INTERESTED IN SUPPLYING MATERIAL FOR AN INSERT IN THE IOCCG INFORMATION FOLDER.

e) Since the last meeting, the IOCCG Project Office had written a promotional article popularizing ocean colour for the Equinox magazine (July, 2000). Another article had been submitted to the Asian Geographic magazine. It was suggested that these articles also be placed on the IOCCG website. Dr. Yoder enquired whether it would be a good idea to have a less formal publication series *e.g.* technical memoranda, that were published on web. Members thought that this was a good idea, and could be considered as an option if, and when, required.

9. Status of Current Ocean-Colour Missions

a) SeaWiFS

Dr. Marra reported that the SeaWiFS spacecraft and instrument were performing very well and that SeaWiFS data was being widely used around the world. A gap in data collection over the Galapagos Islands had been identified, and an HRPT station would be set up there soon. Data was distributed from DAAC to the research community at a ratio of 9:1 (over that received).

b) OCM

According to a statement submitted by Dr. Ranganth Naval Gund, the OCM sensor has been functioning satisfactorily since its launch in May, 1999 and data are being routinely received by the ground station at NRSA, Hyderabad. Level-1 data, as well as some derived products (chlorophyll and sediment distribution), are available to users. Sea Space Corporation have installed a receiving station in the USA to receive OCM data from other global regions, and DLR, Germany are also in the process of setting up a reception station for OCM data. Calibration and validation of OCM data has been carried out through various cruises. A number of agencies in India have been using OCM data extensively for various applications such as fisheries, suspended sediment dynamics, monitoring upwelling regions, monitoring algal blooms, and calculation of primary production. Oceansat-2 is scheduled for launch around 2005/6 and will carry an Ocean Colour Monitor to ensure continuity of ocean-colour data.

c) *MODIS-Terra*

Dr. John Marra reported that most of the problems with MODIS instrument performance had been solved and that software problems were being identified and corrected. The switch to “B side” electronics on 30 October, 2000 had improved stability of the instrument (less noise). Level-2 and -3 products were still beta quality (products have undergone limited testing and validation, caution urged for scientific use), but data quality was expected to be upgraded to “provisional quality status” by June, 2001. The first reprocessing was expected to begin in June/July and unless the reprocessing rate was increased significantly, production of a consistent quality annual time series would take another 6 months.

MODIS data are available from Goddard DAAC to all users, without restrictions. EOS has set an upper limit of distribution of two times the Terra mission data volume, thus there is very limited capability to distribute entire data sets compared to SeaWiFS. Committee members commented that it was vitally important to extend the SeaWiFS mission because of the problems with MODIS.

d) *OSMI*

Dr. Sinjae Yoo submitted a document stating that OSMI had been operating successfully since its launch on 21 December, 1999. OSMI had gathered approximately 2,400 global scenes but preliminary analysis of the data revealed anomalies related to sensor characteristics. This had delayed routine Level-2 and Level-3 processing of the data. Vicarious and inter-sensor calibrations were currently underway, in conjunction with the SIMBIOS Project, to remedy this problem.

10. Future Ocean-Colour Missions

a) *MERIS*

Dr. Rast reported that ENVISAT was scheduled to be launched in mid 2001. He noted that there would be some flexibility after the commissioning phase to incorporate new definitions for $[L_w]_N$. ENVISAT validation activities were based on rolling Announcements of Opportunity (AO). All approved scientific proposals would receive MERIS data free of charge. Validation teams requested that scientists provide access to MOBY data for validation purposes. There was also an interest in processing MERIS data using SeaDAS.

b) *HY-1*

Dr. Jianqiang Liu reported that the Chinese HY-1 mission was scheduled to be launched in May, 2001. The mission was designed to monitor marine environmental parameters of the China Seas, including chlorophyll concentration, suspended sediments, dissolved organic matter, pollutants and sea surface temperature. HY-1 was a relatively small satellite with a working life of around 2 years. It would be placed in a near sun-synchronous orbit at an altitude of 798 km and would have a payload of two sensors: the Chinese Ocean Colour and Temperature Scanner (COCTS) and the Coastal Zone Imager (CZI). The National Center of Satellite Ocean Applications (NCSOA) of the State Oceanic Administration (SOA) would be responsible for acquiring, processing,

archiving, distributing and analyzing data from the HY-1 mission. Two ground stations in Beijing and Hainan province would receive raw data in real time. A successor, HY-1b, carrying similar ocean-colour sensors, was scheduled for launch around 2004.

c) *GLI and S-GLI*

Dr. Tanaka gave a brief presentation on the GLI sensor, which is scheduled to be launched in February 2002. Products would include ocean-colour products ($[L_w]_N$, chl-a, CDOM, suspended sediments, $K490$) as well as sea-surface temperature products. In addition there would be “research” products (not distributed routinely) such as accessory pigments (carotenoids, phycobilin), phytoplankton species (*Trichodesmium*, coccolithophores), natural fluorescence, PAR and primary production. Preliminary test results indicate that saturation is a big problem so additional bands have been proposed to avoid saturation. The operational phase of GLI will start one year after launch. Data from MOBY, CalCOFI and a mooring buoy off Ishigaki Island will be used for vicarious calibration. Field activities include collaboration with Japanese Institutes, SIMBIOS, MODIS, MOBY and other groups in GLI.

d) *CNES Programme (POLDER-II and HIBISCUS)*

Dr. Podaire gave a presentation on the POLDER-2 mission, which would be launched onboard ADEOS-2. For the operational phase, there would be new or improved products, and improved processing capabilities and distribution facilities. Regarding absolute calibration (based on Rayleigh measurements) there were still a few remaining sources of error at 443 and 490 nm. The accuracies for inter-band calibration were better than 1% for 565/865 nm (sun glitter) and 3% for 443/676 nm (clouds). Absolute calibration, using natural targets (desert sites) was now a mature technique. The 3 % uncertainty requirement in the visible and NIR bands and could easily be met.

Algorithm improvements for POLDER-2 would include changes to the atmospheric correction algorithms (new approach using directional properties of POLDER to correct for absorbing aerosols) and changes to the bio-optical algorithms (back-scattering coefficient computed from 565 nm band).

A proposal for a new mission called HIBISCUS had been submitted to CNES in May, 2000 and would be devoted to observations of the terrestrial and marine biosphere and absorbing aerosols. The mission would provide space observations of direct anthropogenic effects (land use and cover, coastal areas), indirect anthropogenic effects (land ecosystem phenology, marine ecosystem productivity), aerosols and clouds. The HIBISCUS payload would include three instruments: i) a SeaWiFS-like instrument, with 10-12 spectral bands, 500-1000 m resolution and a daily revisit, ii) an improved POLDER-like instrument designed for land BRDF and C-type aerosols, with 10-20 spectral bands, 2-4 km resolution, daily revisit, and directional and polarization measurement capabilities, and possibly iii) an instrument with 10-20 spectral bands, 100-250 m resolution to observe land cover changes and coastal areas. The HIBISCUS mission had received a positive evaluation from the CNES Science Advisory Group,

with a remark that it required a more detailed study about mission specification and product definition.

Dr. Podaire also mentioned another French/German proposal, called CARBOSAT, which would examine global carbon cycle issues. The requirements would be the same as for HIBISCUS, plus there would be a requirement for atmospheric CO₂ concentration. The possible payload for this kind of mission would be similar to HIBISCUS, and would include an atmosphere payload with a spectrometer to monitor water column CO₂ concentrations with 1% accuracy, and an optional differential absorption LIDAR instrument to measure the vertical distribution of CO₂ (the atmosphere and land/ocean payloads could be placed on different satellites). This proposal had been submitted to ESA Earth Explorer “Core Missions” in August, 2000 but had not been selected. There was a possibility of re-submission to the next NASA/ESSP and ESA/Earth Science Explorer “Opportunity Missions”. This type of mission would require interagency coordination.

Dr. Podaire then reviewed the recommendations from the last EuroGOOS conference on Operational Ocean Observations from Space (October, 2000, Darmstadt). The highest priorities were continuation of the JASON-2 mission (precision altimetry), continuous measurements of SST, wind speed and direction, and support of the concept of Earth Watch missions proposed by ESA to promote transition to operational missions. In this context, ocean colour could be considered as a candidate for subsequent EUMETSAT optional programmes. It was also recommended that efforts be made by Europe to intercalibrate appropriate missions to ensure long-term consistent data sets.

e) *MODIS-Aqua*

Dr. John Marra reported that the launch of MODIS-Aqua would not be before July, 2001, but might slip to December 2001 or later. MODIS would begin production of merged Terra and Aqua daily products 9-12 months after the launch of Aqua. MODIS-Aqua gains had been successfully changed to enable a much better SST performance. A deep-space calibration manoeuvre for IR calibration was critical for both Terra and Aqua SST products, and it was hoped that this would be done in March for Terra.

f) *NPP and NPOES*

Dr. Marra reported that NPP and NPOES were scheduled to provide systematic ocean-colour measurements beyond 2007/8. However, NOAA and DOD defined the parameters of the satellites, one of which had an equatorial crossing time of 5.30 am, which is useless for ocean-colour (the other has a 9:30 am equator crossing). Data products coming out of NPP and NPOES were defined by DOD and would include chlorophyll, sediment transport, bioluminescence and turbidity. The ocean observer study had recently come up with a new set of ocean-colour parameters, which included water-leaving radiances, which was a positive development. The Chairman enquired whether the new parameters met ocean-colour requirements as defined in the IOCCG reports. Dr. Brown replied that the requirements were similar, although the IOCCG recommendations were more stringent. Dr. Marra noted that NPP and NPOES were

operational satellites, and not a research activity and mentioned that several members of the ocean-colour community had expressed concern that the data would not be of adequate scientific quality. He suggested that the IOCCG make a statement expressing their concern about the continuity of ocean-colour data. The Chairman pointed out that he had already written a letter to the Chair of CEOS in this connection, but had received no reply. Committee members suggested it might be too late to influence these two missions.

g) *Overview*

Dr. Marra presented an overview of present and future ocean-colour missions. Committee members again expressed their concern about the quality of data from future ocean-colour missions, and the continuity of ocean-colour observations. The Committee recommended that the IOCCG send another letter to CEOS and NASA, as well as to all other Agencies and Dr. Mary Cleeve, regarding continuity of ocean-colour data and stressing the importance of interagency cooperation. In addition, it was recommended that this item be put on the Agenda of the next CEOS meeting (November, 2001) and perhaps the IGOS and SIT meetings in June, 2001. Dr. Aiken was tasked to produce a draft of the letter.

ACTION 6/13: CHAIRMAN TO REQUEST THAT “CONTINUITY OF OCEAN-COLOUR OBSERVATIONS” BE PLACED ON AGENDA OF NEXT CEOS, IGOS AND SIT MEETINGS.

ACTION 6/14: DR. AIKEN TO DRAFT LETTER TO AGENCIES REGARDING CONTINUITY OF OCEAN-COLOUR OBSERVATIONS.

ACTION 6/15: PROJECT OFFICE TO SEND LETTER REGARDING CONTINUITY OF OCEAN-COLOUR OBSERVATIONS TO AGENCIES AND CEOS.

11. IOCCG Involvement in CEOS and IGOS

a) *Oceans Theme*

Dr. Marra reported that the final version of the IGOS Ocean Theme Report was now available through the IGOS website. He had taken over production of this report from Dr. Eric Lindstrom. The report would serve as a blue print for global operational oceanography and included remote sensing and *in situ* components.

b) *Integrated Global Carbon Observations (IGCO)*

The Chairman noted that the genesis of this theme was different from that of the Oceans Theme. A terrestrial Carbon theme had been initiated by IGOS and was turned into a global carbon programme, initially without consultation of the oceanographers. The IGBP had tried to remedy this situation and the result was the development of the IGCO theme. The text was being written by Dr. Maria Hood (IOC Paris) in conjunction with a small scientific committee, including Dr. Scott Doney. The IOCCG had been approached for comment and the IOCCG reports had been used extensively in the preparation of the report. The report is now in an advanced state of drafting.

c) *CEOS Working Group on Education*

The Project Scientist briefed the Committee on the CEOS ad-hoc working group on Education. The IOCCG were represented on this working group and had submitted a summary of IOCCG training activities for their survey. Dr. Lynch reported that he was also a member of this working group, representing CSIRO. The next meeting of the CEOS WGEdu would be held in India (July, 2001).

d) *IGOS Partnership status*

The Chairman had requested IGOS Partnership status after the IOCCG became an Associate Member of CEOS (November, 1999). At the IGOS meeting in Geneva (May 2000), the IOCCG was informed that there were no criteria for accepting new Partners, and that the Partner's Process paper would be revised. At the next IGOS-P meeting (Rio de Janeiro, November, 2001), it was recommended that new Partners should be proposed by two existing IGOS Partners, and that decisions would be made by consensus. The Chairman noted that there was some benefit to joining the Partnership if the IOCCG was going to contribute to the IGOS themes. Potential nominees could include IGBP, ICSU and the IOC. Elizabeth Gross noted that ICSU or IGBP could include the IOCCG in all the correspondence. Dr. Nicolas Hoepffer suggested it was important for the IOCCG to have a representative on the new GOOS Panel.

12. Training Courses

a) *Training course in Erdemli, Turkey, 11-22 September, 2000*

Dr. Lynch reported that 32 students had attended this two-week training course, which consisted of formal lectures, lab work, computer work and a one-day cruise. Funding was provided by the IOCCG, NATO and the Middle East Technical University (METU). The ship was provided by METU and students received a lot of exposure to various cal/val procedures. The course focused on processing satellite imagery from the Black Sea, but there were some problems in using SeaDAS as the Black Sea was not Case-1. Nevertheless students gained experience in image processing. The SeaDAS computer training and the cruise ranked highly in a survey of the students. Everyone was impressed by the efforts of the lecturers and the enthusiasm of students.

b) *Training course in Bangkok, Thailand, 11-15 December, 2000*

Dr. Tanaka noted that 28 students from South-East Asia attended this one-week training course, which took place at the Asian Institute of Technology. The format consisted of morning lectures and afternoon practical sessions. The main focus of the practical sessions was processing data from OCTS, but also included other ocean-colour sensors (OCI, SeaWiFS and OCM). The trainees were enthusiastic and obtained the necessary skills for processing ocean-colour data.

c) *Status of training course to be held in Ahmedabad, India, 12-23 February, 2001*

Dr. Navalgund submitted a report stating that 10 foreign and 12 Indian students had been selected to attend this training course, which was being sponsored by ISRO and the IOCCG. Lecturers would include Drs. Neumann, Platt and Sathyendranath, as well as several local faculty. The training programme would include formal lectures on various

aspects of ocean colour as well as hands-on experience in processing satellite ocean-colour data, with an emphasis on data from the Indian OCM sensor.

13. Future IOCCG Training Activities

a) Web-based, ocean-colour training course

Dr. Lynch noted that IOCCG training courses required a lot of effort and that it would be helpful if there were a pool of information to draw on. In addition, several students had enquired whether they could obtain credit for the training courses, so it might be feasible to set up a collaboration with a university for a credited programme. Dr. Yoder informed the Committee that web-based teaching was becoming important through US Universities, but the tuition fees were high. Web-courses were generally taught in a certain semester, at a certain time, with weekly tests and were not available on the web year round. In addition, a lot of administrative support was required and preparation of material was very time consuming. Drs. Ulloa and Dr. Morel were of the opinion that web-based courses were a good tool to complement other courses, but are not a stand alone tool, as it was important to have interaction with the students. Dr. Shillington also pointed out that the internet was very slow in many countries, and that it was not always easy to retrieve material, although the web was ideal for imagery and animations. The Chairman agreed that there was some utility for web-based courses, but it would be difficult to evaluate students progress, and the course fees might be an issue. Dr. Yoder suggested that the Committee consider a pre-course unit for background information, such as the first three chapters of Report Number 3, which could be presented interactively. Dr. Lynch agreed to initiate preparation of such a training module for the web (perhaps as a link off the IOCCG web-page) with the help of various people interested in education activities, including Drs, Platt, Marra, Shillington, Yoder, Regner, Asanuma, and Morel. Elizabeth Gross also mentioned that it might be informative to look at the on-line course from the American Meteorological Society.

ACTION 6/16: DR. LYNCH TO INITIATE PREPARATION OF WEB-BASED OCEAN-COLOUR, TRAINING MODULE.

b) Training courses in the South Pacific and Indian Ocean

Dr. Lynch had been approached by Dr. Bill Erb, director of the IOC regional office in Perth, regarding cooperative training initiatives in the South Pacific or Indian Ocean. He suggested that the IOCCG initiate a training course in New Caledonia, where recently a receiving station for SeaWiFS data had been set up, but where there were no SeaDAS processing skills. Funding might be available from the French government or from the IOC regional office in Perth. The Chairman stated that the IOCCG would indeed support this initiative. Dr. Hoepffner mentioned that funding for training might also be available through the European Commission.

ACTION 6/17: DRS. LYNCH, FROUIN AND HOEPFFNER TO START WORK ON THE TRAINING INITIATIVE IN THE SOUTH PACIFIC, AND KEEP THE IOCCG INFORMED.

c) *Training course in Southern Africa*

Dr. Shillington reported that he was prepared to run a remote-sensing training course in Cape Town, which would have some emphasis on ocean colour. The course would take place in November, 2001 and lessons for a BILKO module could be generated by the lecturers. Students would be drawn from South Africa, Namibia, Angola, North Africa and perhaps the Indian Ocean Region and he suggested using “upwelling” as a theme for the training course. Dr. Tanaka mentioned that NASDA would be interested in sending lecturers to train students in the use of ADEOS data. Drs. Lynch, Ulloa and Aiken supported Dr. Shillington’s initiative, and agreed to help with the organization of the course. Dr. Ulloa suggested that it might also be possible to obtain support from SAREC in Sweden.

ACTION 6/18: DR. SHILLINGTON TO PROCEED WITH ARRANGEMENTS FOR A TRAINING COURSE IN CAPE TOWN AND KEEP PROJECT OFFICE INFORMED ABOUT DEVELOPMENTS.

d) *Other suggestions for IOCCG-sponsored training courses.*

Dr. Ulloa mentioned that Dr. Vivian Lutz had enquired about the possibility of an ocean-colour training course in Argentina.

Dr. Tanaka stated that NASDA would continue with their training activities in Thailand, and would conduct another training course at the Asian Institute of Technology, in November/December, 2001. There was a need to continue with this type of training as there were sufficient new students (only half the applicants were able to attend the previous training course).

e) *SIMBIOS offer technical support*

The SIMBIOS Project had offered to send a staff member to instruct at SeaDAS sessions in future IOCCG training courses. They could provide tailored SeaWiFS imagery, as well as first-hand training for SeaDAS image processing.

14. JGOFS Representation

The IOCCG had been requested to send a representative to the next JGOFS Scientific Steering Committee meeting (7-8 July, 2001, Amsterdam), which was timed to be adjacent to the IGBP Open Science meeting. Dr. Hoepffner was available to represent the IOCCG at the JGOFS SSC meeting. Elizabeth Gross mentioned that she might also attend.

15. International Activities to Develop East-Asia Bio-optical Algorithms

Dr. Greg Mitchell gave a presentation of cooperative research activities which have contributed towards international collaboration of merged data sets. He noted that bio-optical data have been collected from various parts of the world including the California Current (CalCOFI), southern ocean (JGOFS), Indian Ocean, East Asia, East China Sea and the Pearl River Estuary. East Asian waters present problems because classic Case-1 algorithms can not be applied. The goal of the research activities was to create robust algorithms for both Case-1 and Case-2 waters, based on a data merger and collaborative

analysis of East Asia *in situ* optical, biological and chemical data sets. Collaboration was established with scientists sampling waters off Hong Kong and Korea, and routine optical data were collected. An on-going, multi-year programme is required to acquire the necessary data to develop an understanding of these waters. He noted that the group would value endorsement from the IOCCG to expand its programmes and to encourage data sharing. The Chairman was encouraged to see multilateral cooperation and recommended that Dr. Gregg submit a report from the Pusan symposium to the IOCCG for a formal response. Dr. Morel suggested that if calibration and validation of satellite data were also carried out during the cruises, the Agencies might be more willing to support the research.

16. Recommendations to POGO Regarding Biological Oceanographic Observations

The Chairman had received a letter from the Executive Director of POGO stating that POGO would be holding a workshop (probably in June, 2001) to design an observational scheme for biological *in situ* measurements that would complement satellite ocean-colour data. They requested that the IOCCG nominate a representative to participate in the workshop, and they also requested that the IOCCG submit a list of the most important biological variables to be monitored at a global scale, from a remote-sensing perspective. Dr. Marra noted that a short meeting would be convened at ASLO next month to discuss the sensors for the ARGO floats. In addition, there would be a meeting in Hawaii to examine the development of new sensors for biogeochemistry. Dr. Marra agreed to submit a report on these meetings to the IOCCG. Dr. Aiken recommended that Fast Repetition Rate Fluorometry should be included on the list to measure photosynthetic quantum efficiency. Drs. Aiken and Marra were tasked to draw up a list. Dr. Marra agreed to attend the meeting as an IOCCG representative.

ACTION 6/19: DR. MARRA TO SUBMIT A REPORT ON DEVELOPMENT OF NEW SENSORS FOR BIOGEOCHEMISTRY.

ACTION 6/20: DR. MARRA TO ATTEND POGO MEETING IN JULY, 2001, AS AN IOCCG REPRESENTATIVE.

ACTION 6/21: DRs. MARRA AND AIKEN TO DRAW UP A LIST OF BIOLOGICAL VARIABLES TO BE MONITORED AT A GLOBAL SCALE, AS REQUESTED BY POGO.

17. Satellite Data Received and Processed at SeaSpace Corporation

Dr. Kota Prasad gave a brief presentation on the activities of the SeaSpace Corporation, a commercial company based in San Diego. SeaSpace has the capability of receiving and processing data from various ocean-colour missions including Orbview-2, MODIS-terra, KOMPSAT-1, OCM, OSMI and HY-1.

18. Announcement of Conference: Optics of Natural Waters

Dr. Kopelevich notified members of the upcoming conference entitled "Current Problems in Optics of Natural Waters" to be held in St. Petersburg, 25-28 September, 2001. The Programme Committee included four IOCCG members (Drs. Marra,

Kopelevich, Frouin and Morel). Dr. Kopelevich requested that the Chairman or Project Scientist make a presentation on IOCCG activities, and that Dr. Marra give a presentation on satellite ocean-colour studies. He also recommended that various agencies give presentations on their sensors. Dr. Kopelevich requested sponsorship from the IOCCG for young scientists to attend the meeting. The Chairman noted that this request would be discussed during the Executive meeting. An announcement of the conference would be placed on the IOCCG homepage.

ACTION 6/22: PROJECT OFFICE TO PLACE ANNOUNCEMENT OF ST. PETERSBURG CONFERENCE ON HOMEPAGE.

19. Membership Rotation

The Chairman reported that four scientific members would be stepping down from the IOCCG Committee this year (Drs. Aiken, Campbell, Frouin and Yoo) to continue the required rotation of the Committee. The Chairman thanked them for their tenure on the Committee and noted that many were still actively involved in IOCCG activities even though they were not still Committee members. He then requested nominations for new Committee members (submitted in private). Dr. Ulloa suggested that someone from Argentina be invited to attend the next meeting, since their SAC-C satellite had ocean-colour capability.

20. Any Other Business

The Chairman stated that he had just received report of a terrible earthquake in India, near Ahmedabad, and was not sure how this would impact on the training course.

21. Time and Place of Next Meeting

The Chairman requested suggestions for venues for the next meeting. Elizabeth Gross noted that the timing of the IOCCG meetings had created administrative problems, in that proposals for funding had to be submitted by the end of the year, at which stage there was no approved programme or budget. She recommended that Committee meetings be held before the end of the year, or, as an alternative, that a small Executive meeting be held later in the year. Dr. Morel offered to host the meeting in Villefranche and Dr. Ulloa suggested holding the meeting in Argentina or Chile.

22. Closure

The Chairman thanked Dr. Frouin and Dr. Gabrielle Ayres for their excellent organization of the meeting. He also expressed his thanks to the Director's Office of Scripps, for covering some of the meeting expenses, including the social functions.

Sixth IOCCG Committee Meeting
La Jolla, California, USA, 24-26 January, 2001

List of Participants

<u>IOCCG Member</u>	<u>Affiliation</u>
Aiken, James	Plymouth Marine Laboratory, UK
Brown, Chris	NOAA-NESDIS, USA
Frouin, Robert	Scripps Institution of Oceanography, USA
Hoepffner, Nicolas	JRC, Italy (Representing Peter Schlittenhardt)
Kopelevich, Oleg	P.P. Shirshov Institute of Oceanography, Russia
Marra, John	NASA HQ, USA
Morel, André	Laboratoire de Physique et Chemie, Marines, France
Platt, Trevor	Bedford Institute of Oceanography, Canada
Podaire, Alan	CNES, France
Rast, Michael	ESA/ESTEC, Netherlands
Shillington, Frank	University of Cape Town, South Africa
Tanaka, Tasuku	NASDA, Japan
Ulloa, Osvaldo	Universidad de Concepción, Chile
Yoder, James	University of Rhode Island, USA

Invited Participants

Asanuma, Ichio	Jamstec/NASDA, Japan
Gross, Elizabeth	SCOR
Liu, Jianqiang	Satellite Ocean Application Service, China
Lynch, Mervyn	Curtin University, Australia
Mitchell, Greg	Scripps Institution of Oceanography, USA
Mueller, Jim	San Diego State University, USA
Prasad, Kota	SeaSpace Corporation, San Diego, USA
Regner, Peter	ESA/ESRIN, Italy
Stuart, Venetia	IOCCG Project Office, Canada
Wang, Menghua	University of Maryland, USA

Apologies

Campbell, Janet	University of New Hampshire, USA
Delu, Pan	Satellite Ocean Application Service, China
Ishizaka, Joji	Nagasaki University, Japan
Navalgund, Ranganath	Indian Space Research Organization, India
Neumann, Andreas	DLR, Germany
Parslow, John	CSIRO, Australia
Schlittenhardt, Peter	JRC, Italy (Represented by Nicolas Hoepffner)
Yoo, Sinjae	KORDI, Korea