

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies



IOC–SCOR International Ocean Carbon Coordination Project

Third Session

Villefranche-sur-mer, France
3–4 October 2008

IOCCP Report No. 10

UNESCO

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IOC-SCOR/IOCCP-III/3
IOCCP Report No. 10
Villefranche-sur-mer, France, October 2008
English Only

Acknowledgement

This document is based on work partially supported by the U.S. National Science Foundation under Grant No. OCE-0608600 to SCOR and OCE-07115161 to UNESCO-IOC. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the U.S. National Science Foundation (NSF).

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1. OPENING

The International Ocean Carbon Coordination Project (IOCCP) promotes the development of a global network of ocean carbon observations for research through technical coordination and communication services, international agreements on standards and methods, advocacy, and links to the global observing systems. The IOCCP is co-sponsored by the Intergovernmental Oceanographic Commission of UNESCO and the Scientific Committee on Oceanic Research.

IOCCP Chair Chris Sabine opened the meeting by welcoming the group to the Laboratoire d’Oceanographie of Villefranche-sur-mer, and thanked the local hosts, Jean-Pierre Gattuso and Lina Hanson. The list of participants is given in Annex I.

The IOCCP is required to rotate the membership of its scientific steering group every 3 years. The Scientific Steering Group is composed of a Chair and approximately 8 members selected for expertise in specific areas of IOCCP activities and ability to provide a global perspective on ocean carbon research and observation activities and plans. For the 2008-2010 term, Chris Sabine (NOAA/PMEL, USA) has agreed to continue as Chair of the SSG, and he is joined by returning members Masao Fukasawa (JAMSTEC, Japan) and Dorothee Bakker (UEA, UK). New members of the SSG for this term include Toste Tanhua (IfM-Geomar, Germany), Alex Kozyr (CDIAC, USA), Ute Schuster (UEA, UK), Melchor Gonzalez (U. Las Palmas de Gran Canaria, Spain), Pedro Monteiro (CSIR, South Africa), and Yukihiro Nojiri (NIES, Japan).

The chair of the SOLAS-IMBER joint carbon coordination group, Truls Johannessen (Uni. Bergen, Norway), also serves as an ex-officio member of the IOCCP SSG. The IOCCP and its sponsors would like to thank the outgoing members for their participation and leadership during these critical first 3 years of the project’s development: Bronte Tilbrook (CSIRO, Australia), Cindy Lee (SUNY-Stonybrook, USA), Helmuth Thomas (Dalhousie, Canada), Cyril Moulin (CNRS, France), and Nick Bates (BBSR, Bermuda).

Sabine reviewed the Terms of Reference of the IOCCP for the new SSG members and noted that in the 6 years since its inception, IOCCP has held 15 workshops or meetings (with another 2 to be held in 2008) and has published and/or co-sponsored the publication of 13 reports, guides, and strategy documents (with another 3 expected from 2008 activities). He noted that the IOCCP is currently leading several large coordination activities and that the project has been steadily growing every year. He cautioned that the SSG needs to ensure that the program doesn’t become over-committed and that it maintains the quality of the activities carried out.

2. ADOPTION OF THE AGENDA

The Chair introduced the Agenda and the SSG members were invited to comment. After a brief discussion, the SSG adopted the Agenda as shown in Annex II.

3. MAJOR PROJECT AREA REVIEWS

3.1 DECADAL CARBON INVENTORIES AND REPEAT HYDROGRAPHY

Chris Sabine provided an overview of this item. He noted that the IOCCP began as a joint effort between the IOC-SCOR CO₂ Panel and the Global Carbon Project as a way of addressing global coordination that went beyond any existing global research program and that would be sustained, providing continuity to coordination efforts, with a strong initial focus on repeat hydrography. During the CLIVAR program, there were many countries with plans to make carbon measurements on hydrographic sections, but no central coordination or communication network. One of the big steps forward was the publication of a revised Guide to Best Practices for Ocean CO₂ Measurements, led by PICES and co-sponsored by the IOCCP. The IOCCP maintains an information database of ongoing and planned carbon hydrography cruises, and links to available data from past cruises at CDIAC. The IOCCP has also co-sponsored global data compilation and synthesis efforts such as the CARINA program and the PICES Pacific Data project to put hydrographic data into a common format database that can be integrated with the GLODAP data set. This will serve as the basis of the carbon hydrography data set upon which the community will build in the future. Despite relatively good coordination for carbon hydrography, there are still problems with coordination of hydrography as a whole, with “rumors” of countries planning hydrographic cruises that are either duplications of existing plans or that do not meet a minimum spatial or depth sampling to be of use for the international effort. The Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP), co-sponsored by IOCCP and CLIVAR, has been developed to address this issue (see Section 2 of this report). The IOCCP will lead the development of a white paper for the OceanObs09 conference to more widely publicize the need to develop an international coordination mechanism for ship-based repeat hydrography.

3.2 OCEAN INTERIOR DATA SYNTHESSES

Toste Tanhua provided an overview of the CARINA work. CARINA was formed as an informal, unfunded project in 1999, organized by Ludger Mintrop and Douglas Wallace in Kiel. The result was the assembly of a large collection of previously unavailable carbon data. During the last couple of years, the CARINA database has grown significantly, and three meetings have addressed data quality control and synthesis issues (CarboOcean – IOCCP meeting in Laugarvatn, Iceland, in 2006; CarboOcean meeting in Kiel, Germany in March 2007; and CarboOcean-IOCCP meeting in Delmenhorst, Germany in November 2007). During this time, the 1st level quality control of the data has continued, new data have been added, and the software for data processing has been further developed. Since the workshop in Kiel, 2nd-level quality control has been performed on almost all the data in CARINA. The CARINA collection now includes data and metadata from more than 180 cruises. Approximately 80% of the cruise data included in CARINA has not been previously available to the community. The majority of the cruises were contributed by European CARBOOCEAN participants; however, valuable additional data is included from the U.S. CLIVAR, WOCE and NOAA programs, as well as from Japan, Canada, Australia and Russia. The CARINA data product will consist of the individual cruise data files, with accompanying meta-data, as well as 3 merged data products (one for each region: Arctic Mediterranean Seas, North Atlantic, Southern

Ocean). The merged data files will contain data adjusted accordingly to the results of the 2nd-level QC. Additionally, the merged data files will contain interpolated missing data and calculated carbon parameters, if possible.

CARINA plans to publish 20 articles and datasets as a special issue in the journal *Earth Systems Science Data* (ESSD). Each dataset will have a Digital Object Identifier (DOI) that will make it possible for datasets to be cited as if they were publications and for data contributors to get recognition for their work. In the Pacific, a similar data synthesis effort is being organized through PICES to put Pacific carbon hydrography data into the GLODAP format and to carry out 2nd-level QC on the data following what was carried out by CARINA. Bob Key is the central data manager who is working with both projects. The PICES effort will be launched at the PICES meeting in 2009, which will give Key time to finalize the Atlantic data. For the Indian Ocean, the SIBER group headed by Raleigh Hood is developing an integrated observing strategy, but this group is not necessarily going to be able to lead an effort like CARINA or PICES for Indian hydrographic data any time soon. Ultimately, Bob Key will be needed to synthesis the Indian Ocean data into the global common database as was done for the Atlantic and Pacific. By the time he is finished with PICES, there may be more hydrographic data for the Indian Ocean based on cruises now planned for 2009-2011. This implies that the Pacific synthesis should be completed no later than 2011.

The SSG discussed how this sort of ocean interior data synthesis effort will evolve in the future. While this first phase of getting existing hydrography data into a common database is labor intensive and relies heavily on one person (Bob Key) to carry on the analysis and formatting, the SSG felt that this may become easier in the future as more data become available and quality control routines are automated. Tanhua noted that it should be possible to develop an automated program to perform the crossover analyses for any new station that is added. At this point, it is critical for data collectors to ensure that data are submitted to CDIAC and to start regularly publishing datasets in ESSD to obtain DOIs for the datasets so that contributors can be recognized more appropriately.

The SSG agreed that the IOCCP should continue to support the data synthesis efforts of CARINA, PICES, and the Indian Ocean as needed. The IOCCP has been very effective at contacting data holders to contribute to these global dataset development efforts and should continue to work with the regional groups and data centers in this way.

Nicolas Gruber, Arne Kortzinger, and Richard Feely are planning a synthesis meeting called “Decadal Variations of the Ocean’s Interior Carbon Cycle: Synthesis and Vulnerabilities” to be held from 13 to 17 July in Switzerland. The SSG agreed that this may be something that will contribute to the synthesis work already carried out and may need IOCCP support.

Action Item 1. The IOCCP should continue to offer support to the regional synthesis efforts as needed, and contact the respective groups to get an update on plans for finishing CARINA, starting the PICES Pacific Ocean effort, and dealing with the Indian Ocean data. (*Responsible: Maria, Chris, Toste. Timeframe: immediate. Financial Implication: low.*)

Action Item 2. The GO-SHIP strategy should clearly describe the desired evolution of how new carbon hydrography data are to be added to the global dataset, including post-cruise processing, use of automated routines, etc. Information should be placed on the IOCCP and CDIAC web-sites now describing what data contributors should do and who to contact if they would like to contribute data to the global dataset. (*Responsible: Maria, Chris, Toste. Timeframe: with GO-SHIP timeframe. Financial implication: low.*)

3.3 SURFACE CO₂ DATA SYNTHESIS WORK

Dorothee Bakker introduced this item. She noted that the SSG would be discussing the SOCAT project in detail during Session 2 of the meeting, but wanted to highlight some issues that should be addressed by the community that are not necessarily part of SOCAT. She noted that there is a big problem with marine biogeochemical data not being stored properly, with no reporting of how the data were collected, and with “public” data not being fully accessible. The SCOR Working Group 131 on The Legacy of in situ Iron Enrichment: Data Compilation and Modeling is working to centrally store data from the iron fertilization experiments and to make those data freely available through the U.S. Biological and Chemical Oceanography Data Management Office (BCO-DMO). This effort will include a commonly agreed data policy for users to best acknowledge the original data producers (e.g., by offering co-authorship and perhaps assignment of digital object identifiers for individual data sets). Obviously, a practical description of methods used, calibration etc. (so-called metadata) will also be included. Bakker also noted that data synthesis efforts are rarely funded, but it is rather simply assumed that data collectors will carry out data synthesis activities as part of their program. She emphasized that data contributors will only work on data synthesis projects when there is a scientific interest to do so and that we need to foster these activities around scientific questions and publications. Several people in the community have suggested that publishing datasets in the new ESSD journal (Earth System Science Data, <http://www.earth-system-science-data.net/>) may help by providing citations for data contributors, but this may take some time to catch on in the community.

Bakker also highlighted the funding gap in Europe for ocean carbon observations and data storage beginning in 2009 for CarboOcean-funded surface pCO₂ and in 2010 for all other CarboOcean data, which will significantly impact North Atlantic data coverage. At present, there are no EU calls for observation programs that could follow CarboOcean. The Integrated Carbon Observing System might provide some support for marine carbon observations, but it is not clear if or when that might happen. Only EuroSITES is funded under Framework Programme 7.

The SSG discussed these funding gap issues and considered whether appealing to political issues of climate change and stabilization of atmospheric CO₂ might help to leverage national support for a global observing program. The SSG noted that

UNFCCC commitments are important to many countries and that we should perhaps make more of ocean carbon as an Essential Climate Variable in the UNFCCC system. The SSG also suggested that ocean acidification could now be a strong argument for carbon system observations, although some members cautioned that this may lead to a decrease in funding for global carbon observations in order to support sea-going biological observations and laboratory experiments for acidification research. It was also recognized that ocean carbon observations might have a better chance of being sustained if the community made a concerted effort to move towards a more operational system (e.g., autonomous sensors reporting data in real time to a dedicated data center). Even though near real-time data release may not be a scientific priority for ocean carbon, it might help to sustain observational programs that will otherwise be seen as individual research projects. This issue was picked up again during the Session 4 discussion of the OceanObs09 conference and the need to prepare white papers for ocean carbon measurement systems.

3.4 SURFACE FLUX MAPS AND DATA ASSIMILATION

Ute Schuster led this discussion. She presented an overview of her group's work in the North Atlantic using MLR and neural network techniques to generate pCO₂ maps. Using these techniques and data from 1990 to present, she showed variability might be linked to NAO forcing, but cautioned that to fully characterize climate mode impacts on carbon flux variability, long-term regular measurements are necessary. Without continuous funding, as anticipated for 2009 and beyond, this will not be possible.

The SSG recalled a discussion from the April 2007 SOCOVV meeting about the possibility of developing a workshop to bring together all the groups generating flux maps using various techniques and suggested that it may be time to investigate the feasibility and interest in the community for this. The SSG suggested that it might be possible to have this meeting as a session of a larger meeting (e.g., ASLO, AGU, EGU). It was also suggested that it might be appropriate as a scoping workshop of the US Ocean Carbon and Biogeochemistry project, along with some other funding and support to make it international. It was also recognized that this is an issue that would more appropriately be coordinated via the SOLAS-IMBER Carbon (SIC) group, since there are no technical coordination issues with this activity. The SSG agreed to pursue this and to begin investigating if and how such a workshop might be developed.

<p>Action Item 3. The IOCCP will determine whether the SIC is willing to provide international coordination for a workshop to bring together groups making ocean carbon flux maps to compare methods. It was suggested that funding and co-sponsorship might come through the U.S. OCB via a scoping workshop, and perhaps the EU COST program. (<i>Responsible: Hood will send a request to SIC. Johannessen and Sabine to serve as focal points. Timeframe: immediate. Financial implications for IOCCP: low.</i>)</p>

3.5 UNDERWAY CO₂ NETWORKS

Pedro Monteiro introduced this item and highlighted South African plans to increase the network in the Southern Ocean, which include 3 cruises per year, two of which go

to at least to 55° South. Monthly cruises are also being carried out across the Benguela upwelling system shelf, approximately 140 km north of Cape Town. This shelf section has been operating for over 11 years, and CO₂ measurements have just begun. Combined with other observations in the region, this new work may lead to an annual carbon flux estimate for the South Atlantic and Southwest Indian Ocean regions. Monteiro also noted that this work is coordinated with other Southern Ocean observations, such as the *Polarstern* cruises, to avoid overlaps. South Africa also has plans to build a new ice-strengthened research/re-supply vessel for polar work to be launched in 2012. Along with the observation work, South Africa is carrying out process studies in collaboration with Princeton University and the Bjerknes Center at the University of Bergen, looking at coupling between the ocean basin and the Benguela region boundary conditions.

Monteiro emphasized that this type of long-term observation program would benefit greatly from having an international strategy, as well as links to the global observing systems and the UN Framework Convention on Climate Change. The South African government will be increasing its funding of science and technology to 1.2% of its GDP. Global and regional climate research forms one of the five themes that will be primarily supported in the coming 10 years, but the programs need to be developing products and deliverables for the global community and illustrating how the South African networks are contributions to the global network.

The SSG discussed other underway and hydrography programs that will be operating in the region over the next years, including *Polarstern* (which will run a section along 60°S this year), the U.S. sections down the prime meridian from the horn of Africa to Antarctica, the Japanese cruise from Cape Town to the Japanese base in Antarctica, and a French cruise.

The SSG agreed that the Southern Ocean is a key area to strengthen to the observation network. Because of the high temporal and spatial variability in the region, it is important to start developing a regional algorithm approach rather than suggesting that we can measure the variability directly. This will be a challenge since it is a very large region with lots of cloud cover that will impede satellite observations. The SSG also emphasized the importance of coordinating the ships making CO₂ observations in the region to make sure they are coordinating routes and sharing data.

The SSG agreed that the VOS network and regional algorithm approach needs to be highlighted as a community white paper for the OceanObs09 conference (see Section 4.5). There is also a SCOR working group that has been proposed to work towards getting more commercial ships to make scientific observations, and we should get a carbon expert to participate in this working group. Hood reminded the SSG that the IOCCP had an action item several years ago to develop a file on shipboard pCO₂ systems for commercial companies that was never finalized, and that a POGO group had also started work on a proposal to encourage shipping companies to include a science compartment on new ships. The SSG also inquired about the former JCOMM / Ship Observations Team group that worked as a liaison between individual scientists and the shipping companies, noting that this service could be critical in the future if commercial observations are significantly augmented. The SSG noted that it might also be helpful to develop a web-site as part of the JCOMM site that would specifically discuss commercial ship operations and highlight the contributions made

by each ship / company as part of the Global Climate Observing System in support of the UNFCCC.

Action Item 4. Contact the developers of the SCOR Working Group on commercial ship observations to see about collaboration and inclusion of carbon in this project. (*Responsible: Ed Urban. Timeframe: Immediate. Financial Implications: low*).

Action Item 5. Develop a small informational document about CO₂ systems on ships that would be appropriate to provide to commercial companies. (*Responsible: Ute Schuster. Timeframe: corresponds to SCOR Working Group in Action Item 4. Financial Implications: low*).

Action Item 6. Contact the JCOMM Ship Observations Team about the status of its liaison service for scientists seeking space on commercial vessels and encourage them to sustain / augment this activity. (*Responsible: Maria Hood. Timeframe: Immediate. Financial Implications: none*).

3.6 INTEGRATED GREENHOUSE GAS MONITORING AND PCO₂ INTERCOMPARISON EXERCISE PROPOSAL

Yukihiro Nojiri presented this item, highlighting the pCO₂ VOS work in the North Pacific that has been running continuously since 1990. He described the new autonomous atmospheric systems that measure atmospheric O₂/N₂, CO, and many other variables. The ocean systems still require someone to operate and monitor the system, although they have advanced now to the point that they can be operated by a trained member of the ship's crew rather than a scientist. He also noted that the ship's crew could do bottle sampling in specific areas. In order to improve the underway pCO₂ systems, Nojiri proposed a new intercomparison experiment to be held early next year in the indoor seawater pool at the National Research Institute of Fishery Engineering, similar to the 2003 intercalibration experiment. This experiment allowed system developers to find errors in their system and to correct them, resulting in a difference of only +/- 1.5 ppm in dry-air xCO₂ of equilibrated air for adequately operated systems. Nojiri proposed to hold the next intercomparison experiment from 26 February to 5 March 2009, although the dates are still somewhat flexible. He would like to finalize the participation by the end of October to allow sufficient time to deal with shipping instruments and equipment. Plans are to publish results that combine the 2003 experiment with the 2009 experiment.

The SSG agreed that a new intercomparison experiment would be useful and agreed that this should be endorsed as an IOCCP activity, and that the IOCCP should assist Nojiri with report editing and publication. Nojiri will begin making the necessary arrangements and invitations.

3.7 OCEAN CARBON DIOXIDE DATA MANAGEMENT PROJECTS

Alex Kozyr introduced this item and provided a demonstration of the data projects at CDIAC, including the CARINA and PICES projects to get hydrography data into the GLODAP format, the Takahashi climatology, and the SOCAT project. He emphasized that the OceanSITES / time-series projects were the weakest, and that CDIAC has very few time-series data.

The SSG noted that the time-series issues should be dealt with at the upcoming “Changing Times” meeting in November. The SSG also noted that CDIAC now has a nice site for coastal carbon data, and that we need to advertise this more widely. This will be used by the SOCAT coastal group. The SSG requested Kozyr to ensure that the version of the Takahashi climatology used for the *Deep-Sea Research* special issue, as well as the most recent version, will be available on-line as well as the most recent version.

4. REVIEW OF MAJOR ACTIVITIES

The IOCCP has developed three major coordination activities to address hydrography, surface CO₂, and time-series networks.

4.1 GLOBAL OCEAN SHIP-BASED HYDROGRAPHIC INVESTIGATIONS PANEL (GO-SHIP)

Both the CLIVAR community and the ocean carbon community have recognized the urgent need for better coordination of planning, implementation, standardization, data synthesis and interpretation efforts for hydrography. The hydrography community has also recognized that today’s hydrography programs address different issues than were addressed during the WOCE era; issues that require a more integrated approach both in terms of variables measured, sampling strategy, and integration of ship-based sampling with other platforms such as Argo and time-series stations.

Following an action set at the International Repeat Hydrography and Carbon Workshop (Shonan Village, Japan, November 2005), the IOCCP, CLIVAR, and the SOLAS-IMBER Carbon Coordination Group are sponsoring the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) to bring together interests from physical hydrography, carbon, biogeochemistry, Argo, OceanSITES, and other users and collectors of hydrographic data, to develop guidelines and advice for the development of a globally coordinated network of sustained ship-based hydrographic sections that will become an integral component of the ocean observing system. Panel Members include Masao Fukasawa (JAMSTEC, Japan), Chris Sabine (NOAA, USA), Bernadette Sloyan (CSIRO, Australia), Toste Tanhua and Arne Koertzing (IfM-GeoMar, Germany), Gregory Johnson (NOAA, USA), and Nicolas Gruber (ETH, Switzerland).

Terms of Reference:

- i. To develop the scientific justification and general strategy for a ship-based repeat hydrography network, building on existing programs and future plans, that will constitute the core global network, post-CLIVAR; considerations should include:
 1. a set of basic requirements to define a coordinated repeat hydrography network (e.g., sample spacing, repeat frequency, recommended core measurements, etc.);
 2. an inventory of existing and planned sections that meet those criteria;
 3. an assessment of other observing programs that can either contribute to or use hydrography data (e.g., Argo, OceanSITES, GEOTRACES, etc.);

4. an assessment of data release needs to meet research and operational objectives;
 5. an inventory of on-going or planned scientific synthesis activities (basin and global) that might benefit from closer collaboration;
 6. guidelines for the transition from the CLIVAR hydrographic program to the new system, including sections, data and information management, and synthesis activities.
- ii. To develop guidelines for a single global information and data center for ship-based repeat hydrography;
- iii. To review and provide guidance on the need to update the WOCE hydrographic programme operations manual, including a review and update of data quality control issues.

It is envisaged that the advisory group will develop a report within a <2 year period that will be circulated widely for consultation and consensus on the way forward. The final strategy will be presented at OceanObs09. This document may then be used by the sponsoring organizations as well as national agencies to develop a coordinated network of ship-based repeat hydrography that will contribute to the global ocean/climate observing system.

The first meeting was held on 1-2 November 2007 during the PICES annual meeting, and all members except Gruber attended. The agenda covered review and approval of Terms of Reference, science goals, temporal and spatial sampling considerations, recommended core measurements, contributions from other platforms, data release and sharing, data synthesis, data and information management needs, revision of the WOCE hydrographic programme operations manual and needs for new standards or methods, the way forward with development of the strategy and plans for the next meeting. A draft strategy was developed at the meeting, and the Panel members will continue to work on this via email over the next several months with a view to making it public for community review in late 2008. Revision of the WOCE hydrography programme operations manual began in April, with the goal of having first drafts on-line for community review by September 2008. Alex Kozyr has developed an on-line community review system on the CDIAC web-site.

The initial project deadlines have slipped by several months because it was not possible to hire a consultant to oversee the strategy development as originally planned. The GO-SHIP panel agreed to develop a short version of the strategy, if necessary, to begin circulating to the community. The section that is taking the most time to complete is the scientific justification section, which was not considered to be essential before beginning community discussions about the strategy.

It was also recognized that a more effective means of communicating with the international hydrography community is needed, and that an email list should be developed based on the US CLIVAR and Carbon Hydrography Program, the CLIVAR and Carbon Hydrographic Data Office (CCHDO) lists, the IOCCP hydrography meeting participants list, and others. This should be completed by the end of 2008, before the strategy is circulated.

One of the Terms of Reference for the group is to develop guidelines for a single global information and data center for repeat ship-based hydrography. In consultations with the CCHDO staff, a suggestion has been made to host a comprehensive, integrated ship-based repeat hydrography web-site at CCDHO, but to provide administrative access to the IOCCP project office so that we can assist in developing content and keeping the information up to date. A meeting between CCHDO staff and the IOCCP project director is scheduled for November 2008 to discuss how this could be done and the desired content. This would also be an issue for the GO-SHIP panel to discuss, and to have input from the wider community.

Discussions and Decisions:

The SSG noted that the OceanObs09 conference will represent the deadline for much of this work, including the strategy (white paper) and publication of the revised manual. Hood noted that OceanObs09 should mark the end of the mandate for the GO-SHIP Panel and that continuation of the effort to develop a global strategy, post-CLIVAR, will depend on the response of the community to the white paper, and on having a few champions step forward to agree to lead the development of a coordination project.

The SSG also agreed that coordination is needed now, especially an email list to allow rapid communication with the international hydrography community, and a web-based bulletin board/news service. This will also be needed to appropriately circulate the white paper strategy.

Action Item 6. Develop a communication / coordination activity for repeat ship-based hydrography as an interim activity between now and the time the GO-SHIP strategy is published and follow-up activities are developed. (*Responsible: Maria Hood. Timeframe: Immediate. Financial Implications: low*).

4.2 THE SURFACE OCEAN CO₂ ATLAS (SOCAT) PROJECT

At the “Surface Ocean CO₂ Variability and Vulnerability” (SOCOVV) workshop in April 2007, co-sponsored by IOCCP, SOLAS, IMBER, and the Global Carbon Project, participants agreed to establish a global surface CO₂ data set that would bring together, in a common format, all publicly available surface fCO₂ data for the surface oceans. This is an activity that has been requested by many international groups for many years, and has now become a priority activity for the marine carbon community. This data set will serve as a foundation upon which the community will continue to build in the future, based on agreed data and metadata formats and standard 1st-level quality-control procedures, building on earlier agreements established at the 2004 Tsukuba workshop on “Ocean Surface pCO₂ Data Integration and Database Development”. This activity also supports the SOLAS and IMBER science plans and joint carbon implementation plan.

This data set is meant to serve a wide range of user communities and it is envisaged that, in the future, 2 distinct SOCAT data products will be made available:

- a 2nd-level quality controlled, global surface ocean fCO₂ (fugacity of CO₂) data set following agreed procedures and regional review, and

- a gridded SOCAT product of monthly surface water $f\text{CO}_2$ means on a $1^\circ \times 1^\circ$ grid with no temporal or spatial interpolation.

An extended 1st-level quality-controlled data set has been developed as part of the EU CarboOcean project, where Benjamin Pfeil and Are Olsen (Bjerknes Centre for Climate Research) have compiled the publicly available surface CO_2 data held at CDIAC (Carbon Dioxide Information Analysis Center) and other public data into a common format, 1st level quality-controlled, database based on the IOCCP-recommended formats for metadata and data reporting. The first SOCAT data compilation (version 1.1), available in May 2008 to SOCAT participants, already includes data from over 10 countries, producing an initial database composed of more than 1250 cruises from 1972 to 2007 with measurements of various carbon parameters.

A small technical meeting was held in Bremen, Germany, on 5 December 2007 (associated with the 3rd CarboOcean Annual Meeting) to agree on 1st-level QC for the data set and to decide on a way forward for the 2nd-level QC issues.

The IOCCP, along with CarboOcean and the SOLAS-IMBER Joint Carbon Group, held a 2nd technical workshop (SOCAT-2 meeting) at UNESCO, Paris, on 16-17 June 2008 to develop internationally agreed 2nd-level quality-control procedures and to discuss the coordination of regional scientific groups to conduct the 2nd-level quality control analyses. Refer to the background document SOCAT-II Report for more information.

http://ioc3.unesco.org/ioccp/Docs/SOCAT2_Final2.pdf

Action items from the SOCAT-2 workshop in Paris and current status are:

- 1: Coordinate with OceanSITES on the Platform Names / Codes for time-series stations (Pfeil, Olsen, Kozyr, Hood). STATUS: Pfeil has reviewed the code system provided by OceanSITES.
- 2: Develop a separate data set of $x\text{CO}_2$ in dry air to compare with long-term atmospheric monitoring stations and GlobalView. The $f\text{CO}_2$ in air and the difference between $f\text{CO}_2$ in air and water should be added to the main data set eventually, but should be left to future SOCAT versions (Pfeil, Olsen, Hankin, Malczyk). STATUS: to be dealt with later.
- 3: Test the multiple linear regression (MLR) approach in one area to see how difficult this is. (Regional groups) STATUS: Not done
- 4: Decide on regional definitions and how to deal with cruises that cross boundaries (Regional groups, Pfeil, Olsen, Hankin, Malczyk) STATUS: Pfeil, Hankin, and Malczyk have discussed this issue for the live-access server (LAS) system.
- 5: Develop a recommended procedure for providing information about binning (e.g., the number of data points, the number of cruises and the standard deviation of the data.) (Sabine, Schuster, Wanninkhof) STATUS: Not yet carried out.

6: Benjamin Pfeil, Maria Hood and Alex Kozyr will identify data contributors whose data are probably open for data sharing but not yet at CDIAC. STATUS: Completed. Several million new measurements were added to the dataset following a round-up of approximately 40 PIs by Hood and Pfeil.

7. Regional group chairs will establish their groups and all groups will look through the SOCAT version 1.1 data set to identify data sets that are missing and provide that information to Pfeil. Pfeil, Kozyr, and Hood will contact data contributors to include those data in the SOCAT data set before the 1 September deadline. STATUS: Data round-up is complete. Regional groups have not fully formed.

With many data added in response to Action Item 6, the next version of the SOCAT dataset will not be ready for review by the regional groups until January 2009. At that time, the regional groups are asked to carry out 2nd-level quality control on the SOCAT data and address key process-related scientific questions requiring large-scale joint synthesis efforts, while aiming for scientific presentations at ICDC-8 (International Carbon Dioxide Conference) in September 2009 and a first public release of the two SOCAT products by late 2009.

Discussion and Decisions:

The SSG agreed that it is critical to get the regional groups developed as soon as possible to not lose momentum and enthusiasm in the project. The identified groups and leaders are:

- Atlantic and Arctic Ocean– Ute Schuster and Nathalie Lefèvre
- Indian Ocean– VVSS Sarma
- Pacific Ocean – Dick Feely is 30N-30S + South Pacific. PICES has been asked to lead this. Nojiri to help lead.
- Southern Ocean – Bronte Tilbrook with Nicolas Metzl as co-chair.
- Coastal seas – Alberto Borges and Arthur Chen.
- Global group – Dorothee Bakker, Are Olsen, Chris Sabine, Benjamin Pfeil, Nicolas Metzl

Follow-up of the regional group activities is a challenge. The coastal group is planning a meeting in Kiel in January 2009 with financial support being assembled by the SOLAS International Project Office from various sources including the European COST Action 735. At the SOCAT-II technical meeting in June 2008, the SIC agreed to lead the scientific synthesis part of the SOCAT project. However, with the exception of the coastal group, the regional groups have no support (financial or project office) and have not begun to form. The IOCCP SSG noted the urgent need to put the SOCAT project on sound financial footing and to not lose momentum on this activity. The SSG strongly encourages SOLAS and IMBER to support the synthesis part of SOCAT as a major SIC initiative. The SSG also agreed that the IOCCP should continue to push the development of the SOCAT dataset as a priority, with SIC support where possible. PICES has been approached about leading the Pacific group.

The SOCAT dataset is now very large, containing over 2000 cruises. Benjamin Pfeil and Steve Hankin have agreed that the best way to access the dataset is to keep each cruise as an individual file and to use the LAS system to serve all the data. The regional groups will need to use LAS to download data, based on definitions of regional boundaries. The coastal boundary was agreed to be anything less than 200 meters depth, and LAS can extract these regional data from the regional and global dataset. Because the dataset is now based on individual cruises, most of the flags will be for cruises rather than individual data points. The first level of flags will be available in a look-up table. Using property-property plots, for example, outliers can be identified and flagged as “need more investigation”, while automatically marking the data in the table as questionable.

The LAS developers are concerned that users will be initially overwhelmed by the system and analytical tools provided, and the SSG decided that the best course of action would be to have a single meeting of all the regional groups together with the LAS experts to spend 1-2 days teaching people to use the LAS system, and then for the regional groups to meet in breakout sessions to begin looking at possible 2nd-level QC procedures. The LAS developers report that all the tools should be available by January 2009.

The SSG discussed the possibility of having the regional groups all get together in conjunction with the coastal group’s meeting in Kiel in January 2009. Nojiri pointed out that it may be easier to have the Atlantic and perhaps Southern Ocean group meeting along with the coastal meeting in Kiel, but that it would be easier for the Pacific group to meet later in Tsukuba. Nojiri suggested that he could provide some funding to invite 4-5 participants to attend a meeting, perhaps to be held just after the February/March intercomparison experiment.

Action Item 7. Investigate the feasibility of having a meeting for the Atlantic, Southern Ocean, and Coastal groups to work with the SOCAT dataset in LAS around the time of the Coastal meeting in January in Kiel. (*Responsible: Maria Hood. Timeframe: Immediate. Financial Implication: Medium*).

Action Item 8. Investigate the feasibility of having a meeting for the Pacific group to work with the SOCAT dataset in LAS in March following the intercomparison experiment in Tsukuba. (*Responsible: Maria Hood / Yukihiro Nojiri. Timeframe: Immediate. Financial Implication: Medium*).

4.3 CHANGING TIMES: AN INTERNATIONAL OCEAN BIOGEOCHEMICAL TIME-SERIES WORKSHOP

Time-series studies comprised a major component of the Joint Global Ocean Flux Study and are providing a continuing legacy of biogeochemical observations over time frames that are now becoming long enough to examine a range of climate forcing. The Hawaii Ocean Time-series, Bermuda Atlantic Time-Series and Carbon Retention In A Colored Ocean time-series, for example, now have close to twenty years’ of data including a wide array of biogeochemical observations in different ocean regions. Literally, hundreds of publications have come from the time-series sites and a whole generation of scientists has had some connection to these sites.

Despite repeated acknowledgement by the international community that time-series stations are critical for understanding the processes controlling ocean carbon and biogeochemical cycles, maintaining funding support for these platforms has been difficult. Without a coordinated network of scientists using the stations in an organized effort, the community has become dispersed, and research carried out on the stations has focused more on individual PI-based investigations or sensor development. Without international support, it is possible that many stations will not continue in the future.

In 1999, an international group of scientists formed the OceanSITES program to develop a coordinated, interdisciplinary international network of stations, research programs, and scientists to sustain and enhance the use of time-series observations. Although the physical oceanographic community is strongly tied into OceanSITES, the biogeochemical community is not.

To support and strengthen the ocean carbon and biogeochemical time-series effort, the IOCCP, OceanSITES, and the Partnership for Observations of the Global Ocean (POGO) are sponsoring a workshop at the Scripps Institution of Oceanography on 5-7 November 2008. The Scientific Committee includes Chris Sabine (Chair, NOAA/PMEL, USA), Richard Lampitt (NOC, UK), Bob Weller (WHOI, USA), Uwe Send and Tony Koslow (SIO, USA), Melchor Gonzalez (Uni Las Palmas, Spain), Nick Bates (BBSR, Bermuda), Matt Church (UH, USA), and Trevor Platt (BIO, Canada).

The goals of the meeting are to mobilize the community to participate in this international network and to highlight the critical research that can only be carried out using time series (both ship-board and autonomous) observations. The workshop will also assess the future of time-series observations in an age when it is becoming technically feasible to develop basin and global scale networked arrays of ocean time-series stations, offering a new tool with enormous potential to cover a range of spatial and temporal scales never before possible. The time is right for the international ocean carbon and biogeochemistry community to examine how time-series observations can be used most effectively to advance our understanding of ocean processes and how these processes vary in time and space. Specific goals of the workshop are

- To identify on-going activities and plans using time-series observations;
- To examine the suite of observational methods and try to develop standard approaches that will allow more direct comparison of results from different sites;
- To review emergent science from the existing ocean time-series sites;
- To review the balance between ship-based and moored time-series sites;
- To identify carbon and biogeochemistry research priorities that can best be addressed through time-series observational programs;
- To analyze gaps in the network for addressing research priorities;
- To encourage and facilitate the development of new collaborations using time-series networks;

- To explore the potential for using basin-scale and globally networked time-series stations;
- To inform the ocean carbon and biogeochemistry community of the OceanSITES global network and data management system for the array; and,
- To facilitate incorporation of ocean time-series data into model ground-truthing, sensitivity and error analyses, and model-data fusion activities.

The meeting will bring together approximately 45 scientists from 18 countries. The draft agenda is outlined below:

DAY 1 – November 5	
0900 – 0930	OPENING: Welcome and intro of organizing committee and sponsors (Sabine) Logistical information (Koslow) Goals for Meeting and overview of workshop organization (Sabine)
0930 –1030	SESSION 1: Scientific rationale for sustained Time Series observations of carbon and biogeochemistry (20 min talks) <ul style="list-style-type: none"> • BATS science overview – Mike Lomas • CARIACO science overview– Eduardo Klein • ESTOC science overview– Melchor Gonzalez
1030 - 1050	Break
1050 – 1130	<ul style="list-style-type: none"> • HOT science overview – Matt Church • CalCOFI science overview – Tony Koslow
1130 – 1200	SESSION 2: The scientific value of networking observations (30 minute talks) <ul style="list-style-type: none"> • Evolution of Time-Series Stations: JGOFS to Present (Tommy Dickey)
1200 – 1330	Lunch
1330 - 1500	<ul style="list-style-type: none"> • The value of networking TS observations (Richard Lampitt) • The value of networking TS platforms (Steve Emerson) • Satellite TS and links to in situ observations (Trevor Platt)
1500 – 1520	Break
1520 - 1635	SESSION 3: Global and Regional Programs (10 minute talks plus 5 minute Q/A) <ul style="list-style-type: none"> • OceanSITES – Uwe Send • EuroSITES – Richard Lampitt • ChloroGIN Program – Nick Hardman-Mountford • NOAA Carbon Programs – Chris Sabine • OOI – Uwe Send
1635 - 1735	SESSION 4: Needs, Interests, and Emerging Issues (20 minute talks plus 10 minute Q/A) <ul style="list-style-type: none"> • US OCB Interests and Needs – Debbie Bronk • Ocean Acidification – Dick Feely
1735 - 1900	Close of day 1 and reception

DAY 2 – November 6	
0900 – 1040	<p>SESSION 1. Overviews of Time-Series Stations – (5 minute talks)</p> <ol style="list-style-type: none"> 1. Iceland / Irminger - Jon Olafsson (Iceland) 2. Labrador Sea-Kamiko Azetsu-Scott (Canada) 3. ANIMATE carbon / EuroSITES-Doug Wallace(Germany) 4. DYFAMED/MOOSE-Franck Touratier (France) 5. Carbon-OPS-Nick Hardman-Mountford (UK) 6. OWS Mike- Ingunn Skjelvan (Norway) 7. Baltic Sea-A. Rutgersson Owenius (Sweden) 8. PIRATA- Milton Kampel (Brazil) 9. Gulf of Maine-Doug Vandermark (USA) 10. Cape Verde Station – Doug Wallace (Germany) 11. Line P-Lisa Miller (Canada) 12. A lines-Tsuneo Ono (Japan) 13. EQPAC-Richard Feely(USA) 14. Monterey Bay-Francisco Chavez (USA) 15. Chile Time Series - Oscar Pizarro (Chile) 16. Ensenada Time Series – Martin Hernandez-Ayon (Mexico)
1040 - 1100	Break
1100 – 1130	<p>Overviews, continued.</p> <ol style="list-style-type: none"> 1. GOA time series-VVSS Sarma(India) 2. NIWA sites-Kim Currie (New Zealand) 3. PULSE-Tom Trull (Australia) 4. King George Island-Young Chul Kang (Korea)
1130-1230	<p>SESSION 2: Open Discussion – What are our collaboration and networking needs, interests, and possibilities?</p> <p>Chair: to be determined Reporter: to be determined</p>
1230-1330	Lunch
1330-1500	<p>SESSION 3: Breakout Groups for Basin Compilations</p> <ul style="list-style-type: none"> • Complete list of who is doing what where (can do in advance with written reports) • Major science drivers (basin and global) • Major observation system development priorities for the next 5-10 years • Which of these require regional or global coordination? • Networking and coordination needs (platforms, data sharing, standards, etc.) <p>Atlantic Chair - D. Vandermark; Reporter: K. Azetu-Scott Pacific+S.O.+Indian Chair – K.Currie; Reporter: Lisa Miller</p>
1500 - 1520	Break
1520 - 1620	Breakout Groups continued (drafting report...)
1620 - 1730	<p>SESSION 4: Group Reports to Plenary</p> <ul style="list-style-type: none"> • Group reports and open discussion

DAY 3 – November 7	
0900 – 1000	SESSION 1: Technology and Development Issues <ul style="list-style-type: none"> • Technology Overview - Ken Johnson • Future TS opportunities through Remote Sensing – Jim Yoder • Capacity Building from Time-Series Stations – Doug Wallace
1000 - 1030	SESSION 2: Summary Review of Needs and Interests for Global Cooperation <ul style="list-style-type: none"> • Review and Discussions - Chris Sabine, Maria Hood (reporter)
1030 - 1100	Break
1100 – 1230	SESSION 3: Where do we go from here? <ul style="list-style-type: none"> • OceanSITES framework for coordination and possible responses to the needs and interests from carbon and bgc community – Send / Lampitt • Open Discussion on how to integrate coordination activities into the framework of OceanSITES
1230 - 1330	Close of Meeting / Lunch
1330 – 1500	Steering Committee Session – final drafting, action item assignments, practical programmatic considerations.

Discussions and Decisions

The Group agreed that time-series coordination has not progressed in the carbon and biogeochemistry community as far as hydrography or VOS, and that this needs to be a priority if we hope to keep funding for these sites. The Changing Times workshop will most likely be the first of a series of meetings and actions to tackle the expanded coordination needs.

5. REVIEW OF ACTIVITIES REQUIRING DECISIONS ABOUT FOLLOW-UP

5.1 OCEAN CARBON SENSOR DIRECTORY

The OceanSensors08 workshop was held at the Leibniz Institute for Baltic Sea Research, IOW, in Warnemünde, Germany, from 31 March to 4 April 2008 (<http://www.oceansensors08.org/>). In special sessions, draft white papers were discussed, including for sensors for fluxes through the sea surface (headed by Arne Körtzinger, IFM-GEOMAR, Germany), and sensors and instruments for oceanic carbon measurements (headed by Ute Schuster, UEA, UK). Manuscripts are now being prepared for submission to a special issue in the journal of *Ocean Science*, <http://www.ocean-science.net/index.html>.

In addition to the manuscript for oceanic carbon measurements, an internet-based directory of sensors and instruments has been developed by the IOCCP. The first version site can be viewed at: [www.ioccp.org >Sensors](http://www.ioccp.org/Sensors). The development of this directory stimulated great interest by the workshop participants, as it provides an overview of available technologies of interest to scientists aiming to start oceanic carbon measurements and to developers aiming to improve on technologies utilized. The issue of Technology Readiness Levels (TRLs, see e.g.

http://en.wikipedia.org/wiki/Technology_Readiness_Level), was also discussed. TRLs have been adapted for marine research, where the aim is to provide documentation (publications, cruise reports, laboratory reports, project reports, etc.) that describes the level of development for each sensor or instrument.

The IOCCP should continue to develop this directory and actively seek input and suggestions from the ocean carbon community. Web statistics show that this is the second most often viewed page on the IOCCP site, with approximately 300 visits after the site was published, down to an average of 45 visits per month thereafter.

Discussion and Decisions:

Schuster informed the SSG that papers from the meeting have been submitted to a special issue of the journal *Ocean Sciences*. The special issue was planned to be ready for the OceanObs09 conference with a white paper on new technologies. However, deadlines have slipped and no one seems to be taking the lead to coordinate this, so it is possible that the special issue will not be published in time for the conference. Schuster felt that the carbon sensor paper would not have as much impact without being in the context of a special issue, but that something like this is still needed to identify priorities and needs for future technology development.

As the IOCCP sensor directory generated much interest at the workshop, the SSG agreed that it was important to keep this directory as complete and up-to-date as possible, and Hood should contact the sensor developers to encourage them to provide references to methods papers. A new intercomparison project being planned by the Alliance for Coastal Technologies has brought together several commercial companies with carbon sensors that are not currently on the IOCCP site. The SSG decided that the IOCCP sensor directory should be renamed as “Sensors and Instruments”.

5.2 SOUTHERN OCEAN OBSERVING SYSTEM

The IOCCP has established a small group to provide input to the strategy development of the SCOR/SCAR/POGO/CoML/GOOS Southern Ocean Observing System. The group consists of Nicolas Gruber (ETH, Zurich), Bronte Tilbrook (CSIRO, Australia), Chris Sabine (NOAA/PMEL, USA), Nicolas Metzl (L’Ocean, France), Mario Hoppema (AWI, Germany), Dorothee Bakker (UEA, UK), Andrew Lenton (L’Ocean, France), Pedro Monteiro (CSIR, South Africa), and Richard Bellerby (Uni Bergen, Norway).

The IOCCP developed a background document on carbon observations for the Southern Ocean for the planning meeting held on 1-3 October 2007 in Bremen, Germany and Mario Hoppema attended. Richard Bellerby attended the follow-up meeting in St Petersburg, Russia in July 2008. Richard Bellerby is a member of the SOOS Panel and has offered to represent the group at future meetings.

Discussions and Decisions:

The SSG agreed that this effort does not require any further input from IOCCP and that the SOOS group should be encouraged to integrate the information already provided. SCOR, as a co-sponsor of this activity, will make a special effort if needed

to ensure that the IOCCP document is used in the development of the strategy. Pedro Monteiro agreed to be the IOCCP focal point to keep track of this activity.

5.3 EU PROJECTS: EPOCA AND COCOS

The EU FP7 Integrated Project EPOCA (European Project on Ocean Acidification) was launched in June 2008 for 4 years. The overall goal is to advance our understanding of the biological, ecological, biogeochemical, and societal implications of ocean acidification. EPOCA aims to document the changes in ocean chemistry and biogeography across space and time; determine the sensitivity of marine organisms, communities and ecosystems to ocean acidification; integrate results on the impact of ocean acidification on marine ecosystems in biogeochemical, sediment, and coupled ocean-climate models to better understand and predict the responses of the Earth system to ocean acidification; and assess uncertainties, risks and thresholds ("tipping points") related to ocean acidification at scales ranging from subcellular to ecosystem and local to global.

The EPOCA consortium brings together more than 100 researchers from 27 institutes and 9 European countries (Belgium, France, Germany, Iceland, The Netherlands, Norway, Sweden, Switzerland, United Kingdom).

The IOCCP is a no-cost partner in EPOCA to facilitate links between EPOCA activities and non-EU projects and scientists. The IOCCP has specifically committed to 2 activities: providing support for a training program "Fundamentals of Marine Carbon Biogeochemistry" under the leadership of Richard Bellerby (University of Bergen, Norway), and co-sponsoring a workshop to reach agreements on best practices for ocean acidification research and data reporting (see that section, this report). The training workshop is currently scheduled for early 2009 in Bergen, Norway. The IOCCP will provide financial support for 1-2 instructors and provide guidance on the agenda and workshop plans.

The EU project "Coordinated Action Carbon Observing System" (or COCOS), coordinated by Han Dolman at Vrije Universiteit, Amsterdam, aims to develop common methodologies, standards, data management systems and protocols to increase the cost-efficiency of European (and global) carbon observations by avoiding duplication and facilitating data sharing. This will be achieved by working towards a coordinated system of integrated global carbon cycle observations, encompassing the ocean, the land and the atmosphere, and including in situ as well as, to a lesser extent, remotely sensed observations. It will improve the interoperability of existing and new datasets. Interoperability is defined (www.ieee.org) as "the ability of two or more systems or components to exchange information and to use the information that has been exchanged"; hence the coordination action is organized around two main lines: (1) improving the exchange of datasets between projects, and (2) facilitating the use datasets between different continental and basin scale projects and programs. The coordination activities of COCOS will contribute to effective monitoring of the carbon cycle at the global level as recommended by GEO and GCOS in supporting the European participation to an international CO₂ research monitoring project. The research and harmonization work developed in this proposal will contribute significantly to building an integrated global approach that promotes close collaboration with the international carbon cycle research community. This work

builds on the Integrated Global Carbon Observing strategy developed by the IGOS Partners.

This project will specifically bring together the ocean and land components of carbon research to make sure that we “speak the same language” and that our data are in an interoperable format. For the ocean carbon community, the results from COCOS may affect the way we report and store carbon data and metadata. It will also provide important links between the ocean and land communities in carbon research. The IOCCP is a partner in the COCOS project to facilitate broad input from the ocean carbon community and to coordinate these activities with non-EU initiatives. There are no specific commitments at this time.

Discussions and Decisions:

The SSG agreed to continue to watch developments of COCOS to see how IOCCP can best contribute to this project. The SSG reiterated its support to provide 1-2 speakers for the EPOCA training course, and requested that the EPOCA lead, Richard Bellerby, be asked to develop the presentations from the training workshop as an on-line product.

6. NEW ISSUES FOR CONSIDERATION

6.1 SOLAS-IMBER CARBON GROUP (SIC) REPORT / ISSUES

Truls Johannessen, Chair of the SOLAS-IMBER Carbon Group, presented a review of SIC. There are currently 3 SIC sub-groups: 1) surface ocean systems, chaired by Nicolas Metzl, dealing with the SOCAT project; 2) interior ocean carbon storage, chaired by Nicolas Gruber, dealing with “oxygen sensors on Argo floats” pilot program, and 3) carbon cycle climate sensitivities and feedbacks, currently without a chair. Nicolas Metzl will be stepping down in 2009, and the oxygen on Argo floats pilot project (oxywatch) did not get funded. Work is continuing on an individual PI basis. The SIC has asked the Ocean in a High-CO₂ World planning committee to consider using working group 3 of SIC to carry out international coordination of ocean acidification research. Johannessen emphasized that the future of the SIC will depend on finding funding to support a staff member to work on these activities. He informed the SSG that he is currently writing a proposal to the Norwegian Research Council for support.

Maria Hood noted that the idea of using working group 3 for coordination of ocean acidification research has been discussed at several meetings and has not been supported by the research community, owing to lack of staff, funds, and visibility of this sub-group of the SIC. Ed Urban suggested that Johannessen should request SOLAS and IMBER to outline their vision for interactions with IOCCP on carbon coordination issues under various scenarios; for example, the current situation with no funding and no staff; a situation with a part-time staff member and no funding, etc. The SSG also noted that SIC was unable to hold a meeting this year, and that every effort should be made to organize a joint session at IOCCP SSG-4 (perhaps at the time of the International Carbon Dioxide Conference 8 in Jena, Germany in September 2009).

Action Item 9. IOCCP should send a summary of co-sponsored activities to SIC and request that SIC provide information about their commitment to co-sponsorship and how they envision future interactions with IOCCP given the current state of the SIC. (*Responsible: Maria Hood. Timeframe: Immediate. Financial Implications: none.*)

6.2 UN INTERAGENCY COOPERATION ON OCEAN FERTILIZATION

On 5 February 2008, the Scientific Groups of the International Maritime Organization's Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) and its 1996 Protocol (also known as the "London Convention") requested scientific and technical input from the IOC on the issue of ocean iron fertilization aimed at sequestering atmospheric CO₂, to be presented at the 31st Session of the London Convention Scientific Groups (Guayaquil, Ecuador, 19–23 May 2008).

An informal Consultative Group of Experts was developed to respond to this request, consisting of Dr. Ken Caldeira (Carnegie Institute, Stanford, USA), Ulf Riebesell (IfM-GEOMAR, Germany), Andrew Watson (University of East Anglia, UK), Philip Boyd (University of Otago, New Zealand), and Chris Sabine (NOAA/PMEL, USA). This group developed a statement (http://ioc3.unesco.org/oanet/OAdocs/IOC_OF_Statement%20with%20add.pdf) in response to a series of scientific and technical questions posed by the London Convention Scientific Groups, and the Chair of the Consultative Group, Dr. Ken Caldeira, attended the meeting as an observer.

This input was considered by the Working Group on Ocean Fertilization of the London Convention Scientific Groups in order to determine the implications for protection of the marine environment from ocean fertilization and to provide a scientific and technical basis for evaluating such activities. The decision of the London Convention Scientific Groups was, *inter alia*, that the London Convention Scientific Groups' Statement of Concern Regarding Iron Fertilization of the Oceans to Sequester CO₂ (November 2007) remained valid. That statement (http://ioc3.unesco.org/oanet/OAdocs/IOC_LCSGStatement.pdf) noted with concern the potential for negative environmental impacts and recommended that any such operations be evaluated carefully to ensure that they were not contrary to the aims of the Convention and Protocol. The Scientific Groups also noted that it is important to have scientific and technical expertise included in the delegations when ocean fertilization is discussed further at the next meeting of the governing bodies, and that better coordination is needed among the UN organizations, programmes, and agencies dealing with this issue.

On May 19-30 2008, the 9th Conference of the Parties to the Convention on Biological Diversity (CBD) adopted a decision concerning ocean fertilization activities, referring to the on-going legal and scientific analyses being carried out by the IMO London Convention (<http://www.cbd.int/decisions/cop9/?m=COP-09&id=11659&lg=0>). This decision urges governments to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, with the exception of small-scale research studies in coastal waters. The decision also called for a global transparent and effective control and regulatory mechanism for ocean fertilization activities.

The IOC ad hoc Consultative Group on Ocean Fertilization responded to this decision in an addendum to their original submission to the IMO London Convention, expressing concern about the limitation of experiments to the coastal zone, which may impede legitimate research activities, as well as the lack of distinction between legitimate research activities and those proposed to sequester CO₂ that may fall under the proposed global regulatory mechanism. This addendum was submitted to the London Convention Secretariat and circulated to the Chairs of the Governing Bodies, Scientific Groups, Working Group on Ocean Fertilization, and the Secretariat of the CBD.

The 41st session of the UNESCO - IOC Executive Council (June 2008) reviewed the report by the IOC ad hoc Consultative Group of Experts and recent actions and decisions by IMO and CBD (<http://ioc3.unesco.org/oanet/OAdocs/INF1247-1.pdf>). They agreed that proposals to use ocean fertilization to sequester carbon in the ocean is cause for concern, that there is insufficient understanding of the potential impacts of such activities on the marine ecosystem, and that a precautionary approach is appropriate until safeguards can be established. They further agreed to initiate a UN-interagency partnership with IMO, CBD, and UNEP to coordinate advice and actions on ocean fertilization, and to compile and synthesize scientific information on potential impacts from ocean fertilization for consideration at the 10th Conference of the Parties to the CBD. In addition, they encouraged the IOC to continue to work with SCOR on the Ocean Carbon Sequestration Watching Brief, and to work with the SCOR Working Group 131 in compiling and synthesizing information about ocean fertilization experiments.

An initial discussion between CBD, IMO, and the IOC was held in early September. While it was agreed that a joint database and synthesis of research results would be most useful, the CBD had already proceeded with its compilation of peer-reviewed research results about ocean fertilization impacts on biodiversity, and had already hired a consultant to develop a synthesis from this compilation. The CBD invited the IOC and IMO to review this compilation, to provide information about research results not included in the compilation, and to provide names and contact information for scientists who would be willing to serve as reviewers of their synthesis document. This information was sent to the IOC ad hoc consultative group, and to the chairs of SOLAS (Doug Wallace) and IMBER (Julie Hall). Both projects are keen to be involved in the review and are deciding how to best organize their members to provide a single focal point and coordinated input to the process.

The IOC Chair has requested a summary for policymakers on fertilization that would address the major concerns and questions of Member States. This may be carried out as part of the IOC-SCOR Watching Brief (but with the majority of the Watching Brief focusing on geological sub-seabed storage currently being carried out). Initial ideas are to have the IOC and SCOR develop a series of questions to be addressed (with input from the SCOR Executive Committee and the IOC Chair and Officers) and to have the scientific community respond. It was decided that it would be best to ask the global research programs to assist with this, since an open community exercise may be too patchy and unconstrained to provide balanced input. SOLAS and IMBER were contacted about this. IMBER replied that they would discuss it at their next meeting. SOLAS Chair Doug Wallace is investigating the feasibility of developing a short

proposal for funds to participate in this activity, including partial support for a small editorial group.

Discussions and Decisions:

The SSG identified 3 separate issues requiring attention: 1) the CBD database review and nomination of experts to review the CBD synthesis on impacts of ocean fertilization on biodiversity (deadline in early 2009); 2) the summary for policymakers (deadline April 2009 for the June IOC Assembly); and 3) the IOC-SCOR Watching Brief on Ocean Carbon Sequestration (no specific deadline).

It was agreed that the SSG could rapidly review the CBD database and suggest names of experts for the synthesis review. The SSG agreed that the summary for policymakers should be addressed by the global research programs, and encouraged IOC and SCOR to have a strong input from the Member States into the development of the questions that need to be addressed through such a summary. The SSG also agreed that the Watching Brief should build on results from the Ocean in a High-CO₂ World –II symposium as well as the summary.

Action Item 10. Review the CBD database and suggest names of expert reviewers for the CBD synthesis. (*Responsible: Maria Hood to send to all SSG members. Timeframe: Immediate. Financial Implications: none.*)

Action Item 11. Initiate the development of a summary for policymakers on ocean fertilization, and a new version of the Watching Brief. (*Responsible: Maria Hood and Ed Urban. Timeframe: Immediate. Financial Implications: low.*)

6.3 STANDARDS FOR OCEAN ACIDIFICATION RESEARCH AND DATA REPORTING

The need for standardized protocols and reporting of data has been highlighted at numerous ocean acidification workshops over the past few years. Common methods are crucial if we are to identify differences (or lack thereof) in calcification among various taxa, regions, and over time. It is also imperative that data be reported in a manner that will be comprehensible and accessible to scientists several decades from now if changes are to be detected. Specifically, the international research community needs to establish agreed protocols for calcification rate measurements and mesocosm and perturbation experiments, as well as for protocols for data reporting.

At its kick-off meeting on 10-13 June, the European Project on Ocean Acidification (EPOCA) agreed to merge several standards and protocol activities into a single activity, and the IOCCP agreed to work with EPOCA to develop an international workshop on standards for ocean acidification research and data reporting. The advisory group includes Ulf Riebesell (IfM-GEOMAR, Germany), Deborah Iglesias-Rodriguez (NOC, UK), Jean-Pierre Gattuso, Richard Bellerby (University of Bergen, Norway), Kitack Lee (Pohang University, Korea), Victoria Fabry (California State University at San Marcos., USA), and Dick Feely (PMEL, NOAA, USA).

The meeting will be held on 19-21 November at IfM-GEOMAR in Kiel, Germany in order to meet EPOCA deliverable dates. The workshop will produce short technical reports for each major topic covered (e.g., perturbation experiments, calcification

experiments, etc.), as well as a Guide to Best Practices for Ocean Acidification Research and Data Reporting. Participants at the kick-off meeting pointed out that many experimental aspects of ocean acidification research are still in the development stages and it may be too early to set agreed standards or protocols for many things. It is also clear that one workshop under tight deadlines may not be sufficient to produce a comprehensive Guide. However, participants noted that research is moving forward rapidly and a dialogue about protocols and standards must begin now. There are already many aspects of carbon chemistry applicable to acidification research that have been thoroughly documented in the Guide to Best Practices for Oceanic CO₂ Measurement, and application of these protocols to acidification research would greatly improve the current situation. In the end, the first version of the Guide will most likely end up being a mixture of standards, guidelines, and, most critically, reporting and documentation requirements, so that individual experiments are fully comprehensible and reproducible. To ensure full community participation and input, drafts of the Guide will be made available on-line for open community review period before publishing.

Because of the very early deadlines for developing this workshop, funding has been limited, and participation will be largely European. The IOCCP has committed US \$15,000 to support non-EU scientists to attend the workshop, but the current draft participant list is still not sufficiently international to meet initial goals and objectives. It may be necessary to consider the output of this workshop to be an agreement on best practices for the EPOCA project, rather than a set of internationally agreed guidelines. These EPOCA guidelines could then serve as a basis for a larger, international conference at a later date with appropriate participation and funding support.

Discussion and Decisions:

The SSG stressed that it will be very difficult to achieve international consensus on many methods in only 3 days, but that it is important to start somewhere and to continue to update these recommendations on a regular basis. The SSG also agreed that it would be useful to plan some follow-up activities after the publication of the best practices guide that would be open to students and all scientists interested in reviewing these methods.

The SSG also emphasized that, in many cases, ocean acidification research does not need the high accuracy of ocean carbon research, and this should be kept in mind when developing best practices so as not to exclude routine monitoring work. This also highlights the need for more instrument development to make ocean acidification monitoring more accessible to management authorities, not just the research community.

6.4 CO-SPONSORING THE INTERNATIONAL NUTRIENT SCALE SYSTEM IN SEAWATER (INSS) GROUP

The IOCCP has been requested to support the INSS project. The IOC has committed to provide funds (US \$10,000) to support and host the first workshop at UNESCO on 10-12 February 2009. The IOCCP SSG needs to consider officially endorsing this as an IOCCP activity.

The INSS Organizing Committee includes

- Michio AOYAMA, Meteorological Research Institute, Japan
- Andrew DICKSON, University of California at San Diego, Scripps Institution of Oceanography, La Jolla, CA, USA
- David HYDES, National Oceanography Centre, Southampton, UK
- Akihiko MURATA, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan
- Jae OH, IAEA Marine Environment Laboratories, Monaco
- Patrick ROOSE, QUASIMEME, Wageningen, The Netherlands
- Malcolm WOODWARD, Plymouth Marine Laboratory, UK

Objectives of the workshop are to

1. Update the manual of nutrient analysis.
2. Review the use of nutrient data in oceanography and necessity of INSS.
3. Prepare summary report of 2008 RMNS (Reference Material for Nutrients in Seawater) intercomparison experiments.
4. Update plan for “short-term stability experiment – characterization of RMNS” in 2009–2011;
5. Report on the progress of certification of RMNS by the National Metrology Institute of Japan.
6. Expand current RMNS for DOC, DON and DOP references
7. Organize an international INSS working group under an international organization such as IOCCP-IOC-UNESCO.

Scientific Justification and Background for the Project

The comparability and traceability of data on nutrients in the global ocean are fundamental issues in marine science, particularly for studies of global climate change. Our community has been continuing to improve the comparability of nutrient data in many ways, including by intercomparison experiments and the development of nutrient reference materials. However, as *Climate Change 2007 – The Physical Science Basis* (IPCC 2007) stated, adequate comparability and traceability have not yet been achieved. The IPCC 2007 report comments as follows on nutrient comparability:

Using the same data set extended to the world, large regional changes in nutrient ratios were observed (Li and Peng, 2002) but no consistent basin-scale patterns. Uncertainties in deep ocean nutrient observations may be responsible for the lack of coherence in the nutrient changes. Sources of inaccuracy include the limited number of observations and the lack of compatibility between measurements from different laboratories at different times. (Bindoff et al., 2007).

The IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials (GESREM, 1993) drew attention to an urgent need for certified reference seawater for nutrients. Dickson (2001) drew attention to the need to develop certified reference

seawater covering several determinants in the one bottle. During the World Ocean Circulation Experiment (WOCE) period, the WOCE Hydrographic Program Planning Committee (WHPPC) recognized the importance of worldwide comparability of WOCE nutrient data.

In the 1990s a number of studies were organized under the ICES umbrella. These studies were well documented (see Aminot et al., 1995 and Aoyama, 2006 for details). In Europe, this led to the setting up of QUASIMEME (Topping, 1997), which annually validates the procedures of individual laboratories. But this system is inadequate for supporting the traceability that is required to link measurements from day to day in order to improve the overall precision within a laboratory or to achieve a known level of comparability between different laboratories.

In 2000 and 2002, the U.S. National Oceanic and Atmospheric Administration, USA and the National Research Council of Canada (NOAA/NRC) conducted two intercomparisons to certify MOSS-1 (Willie and Clancy, 2000; Clancy and Willie, 2003). However, adequate comparability and traceability of nutrients data have not yet been achieved. Various efforts have been made to change it, but these have been on too small a scale to meet the needs of the global community in measuring nutrients in seawater.

In 2003, Michio Aoyama, of the Meteorological Research Institute, Japan, organized an intercomparison study that included 18 laboratories (Aoyama, 2006; Aoyama et al., 2007). In 2006, Aoyama organized a second intercomparison study that included 55 laboratories worldwide (Aoyama, 2008 in preparation). Both studies clearly showed that the global use of reference materials for nutrients in seawater would greatly improve the comparability of nutrient data worldwide.

In early 2007, Aoyama visited the National Oceanography Centre in Southampton to discuss the results of the inter-calibration. The European participants in the inter-calibration and other interested nutrient chemists were then invited to attend discussions at NOC.

An International Workshop on Chemical Reference Materials in Ocean Science was held in Tsukuba, Japan, on 29 October to 1 November 2007. It focused on the measurement of nutrients and of ocean CO₂ parameters. The current status of available chemical reference materials, especially for nutrient references in ocean science were discussed, and the participants agreed to start a collaborative program, called the International Nutrients Scale System (INSS), to establish global comparability and traceability. The agreements at the workshop in Tsukuba 2007 marked an epoch in the history of nutrient comparability. The 2009 INSS workshop in Paris is a follow-up meeting of 2007 workshop in Tsukuba to advance international collaboration to establish global comparability of nutrients data in the world ocean..

Discussion and Decisions:

The SSG discussed whether or not this is an appropriate activity for IOCCP support. It may be more appropriate as a SCOR working group rather than as an IOCCP coordination activity. Toste Tanhua will be attending the INSS meeting in February, and agreed to serve as the IOCCP focal point for this activity. The SSG agreed to see how discussions go at the INSS meeting and to be officially requested to co-sponsor the group before taking further actions.

6.5 OCEANOBS'09 CONFERENCE

Almost a decade has passed since the OceanObs99 symposium played a major role in consolidating the plans for a comprehensive ocean observing system able to deliver systematic global information about the physical environment of the oceans. The OceanObs09 symposium will celebrate a decade of progress and make a major contribution to chart the way forward for the coming decade. Meeting goals are to highlight the crucial role of the ocean observing system for understanding and predicting climate; demonstrate the societal and economic benefits of the observing system; make clear the challenge of completing and maintaining the core observing system; identify new opportunities for increased capability, such as biogeochemical and ecosystem monitoring; and promote partnerships to sustain and advance development of the system into the 21st century.

The meeting will be held in Venice, Italy, on 21-25 September 2009 (the week after ICDC-8 in Jena). Chris Sabine and Nicolas Gruber are on the Conference Programme Committee.

Discussion and Decisions:

Chris Sabine suggested that the ocean carbon community should participate in the development of 3 separate white papers: GO-SHIP for hydrography, OceanSITES for time series, and a separate document for the carbon VOS network. Groups are requested to submit a 1 page description of the white paper to the OceanObs09 committee for approval. Accepted white papers will be published as proceedings from the conference.

The SSG reviewed the outline of the OceanObs09 conference and stressed that discussions of implementation are missing. It was hoped that the last day, which is still undecided, would be used to discuss existing networks and future needs based on the white papers.

The SSG agreed that the IOCCP did not need to mobilize a large number of ocean carbon scientists to attend the meeting, but rather should put more effort into developing the white papers. Accepted papers will need to be submitted by March for an open community review to be carried out by the OceanObs09 committee.

Action Item 12. IOCCP should coordinated the development of 3 white papers for OceanObs09

- 1) Repeat Hydrography, led by GO-SHIP
- 2) Time Series led by OceanSITES with Sabine and Gonzalez leading for IOCCP
- and 3) Carbon VOS led by IOCCP, with Schuster, Monteiro, Bakker, Nojiri leading for IOCCP. (*Responsible: Maria Hood and Chris Sabine to coordinate / initiate actions*)

Timeframe: immediate. Financial Implication: none).

6.6 DIRECT REPORTING TO THE GOOS SCIENTIFIC STEERING COMMITTEE

Within the Global Ocean Observing System, ocean carbon has been considered to be part of the mandate of the Ocean Observations Panel for Climate (OOPC), and OOPC includes carbon observing system updates in their regular reports to the GOOS Scientific Steering Committee. At the 2008 GOOS SSC meeting, it became clear that the GOOS SSC was not well-informed about ocean carbon observation status or progress, and they invited the IOCCP to begin reporting directly to the GSSC rather than as part of the OOPC. In the past, GOOS has not been willing to consider non-operational systems as part of GOOS, and thus carbon was considered to be a research network. Because so few ocean observation platforms have transitioned to operational status, GOOS is now taking a more inclusive approach about what it considers to be a contribution to the observing system. A progress report was submitted to the GOOS SSC in August in preparation for its 2009 meeting.

Discussion and Decisions:

The SSG agreed that this was a positive evolution and that the GOOS Scientific Steering Committee should be petitioned to add a slot for a carbon / acidification expert on their committee.

Action Item 13. IOCCP should request that the GSSC add a slot for a ocean carbon / acidification expert on their committee. (*Responsible: Maria Hood and Chris Sabine*
Timeframe: immediate. Financial Implication: none).

7. PROJECT OFFICE ISSUES AND BUDGET

7.1 HIRING A NEW IOCCP DIRECTOR

After 10 years managing the IOC's ocean carbon programs, Maria Hood will be leaving the IOC at the end of December 2008, but will continue to work as a part-time consultant for the IOCCP to facilitate the transition to a new director and to assist with the ever-expanding work load of the project. A job announcement was sent out in mid-August to email networks of IOCCP, SCOR, SOLAS, IMBER, CLIVAR, GCP, OCB, GOOS, CarboOcean, and EPOCA to search for a new director. A decision will be made in early October.

The SSG thanked Maria Hood for her contributions to the development of the IOCCP and stressed the importance of having some overlap with the new director to ensure a smooth transition.

7.2 BUDGET REVIEW

As of January 2008, the IOCCP director position is funded through a grant from NSF directly to UNESCO. This grant provides funds for a full-time director and a part-time consultant to staff the IOCCP. This is a 3-year continuing grant with an end date of 31 December 2010.

Program support for the IOCCP is provided by NSF through a grant to SCOR. This is a 3 year continuing grant with an end date of September 2009, and provides US \$40,000 per year to the program. The IOC also provides funding from its regular

budget for the IOCCP project office and for ocean acidification activities. This money is received at the beginning of each year.

Hood reviewed the current status support for the IOCCP, and noted that current commitments (including new commitments identified at this meeting) will require more than 75% of the IOCCP budget, leaving only 25% for new activities in 2009. This is adequate to accomplish existing goals, but the project must not become over-committed or undertake projects outside its core mandate.

7.3 WEB STATISTICS

Hood provided a brief overview of web-statistics from Google Analytics, installed on the IOCCP web-site in March 2007.

- Averaging about 450 visits per month (more on months with newsletters)
- Steady growth from March (averaging 121 visits per month)
- Pageviews = 1000 per month (total number of pages viewed)
- 2178 visits from 74 countries.
- Traffic sources: 61% from referring sites; 29% from search engines; 10% direct traffic.
- 47% of hits are 1 time only; 10% are 2 times, another 8.5% are 51-200 times (regular users)
- Top pages: Index (30%), Sensors (7%), News (7%), hydrography (5%).

Hood highlighted that links from other web-pages are important, and that 1 visitor out of 12 is a regular customer. These are the most important issues for the IOCCP, since the site aims to provide a regular service to the research community, not do outreach to the general public, etc.

The SSG agreed that the structure and content of the IOCCP site is very useful for the ocean carbon community and that it should be maintained in its current style and format.

8. REVIEW OF SCHEDULED ACTIONS

Action Item 1. The IOCCP should continue to offer support to the regional synthesis efforts as needed, and contact the respective groups to get an update on plans for finishing CARINA, starting the PICES North Pacific effort, and dealing with the Indian Ocean data. (*Responsible: Maria, Chris, Toste. Timeframe: immediate. Financial Implication: low*).

Action Item 2. The GO-SHIP strategy should clearly describe the desired evolution of how new carbon hydrography data are to be added to the global dataset, including post-cruise processing, use of automated routines, etc. Information should be placed on the IOCCP and CDIAC web-sites now describing what data contributors should do and who to contact if they would like to contribute data to the global dataset.

(Responsible: Maria, Chris, Toste. Timeframe: with GO-SHIP timeframe. Financial implication: low).

Action Item 3. The IOCCP will determine whether the SIC is willing to provide international coordination for a workshop to bring together groups making ocean carbon flux maps to compare methods. It was suggested that funding and co-sponsorship might come through the U.S. OCB via a scoping workshop, and perhaps the EU COST program. *(Responsible: Hood will send a request to SIC. Johannessen and Sabine to serve as focal points. Timeframe: immediate. Financial implications for IOCCP: low).*

Action Item 4. Contact the developers of the SCOR Working Group on commercial ship observations to see about collaboration and inclusion of carbon in this project. *(Responsible: Ed Urban. Timeframe: Immediate. Financial Implications: low).*

Action Item 5. Develop a small informational document about CO₂ systems on ships that would be appropriate to provide to commercial companies. *(Responsible: Ute Schuster. Timeframe: corresponds to SCOR Working Group in Action Item 4. Financial Implications: low).*

Action Item 6. Contact the JCOMM Ship Observations Team about the status of its liaison service for scientists seeking space on commercial vessels and encourage them to sustain / augment this activity. *(Responsible: Maria Hood. Timeframe: Immediate. Financial Implications: none).*

Action Item 7. Investigate the feasibility of having a meeting for the Atlantic, Southern Ocean, and Coastal groups to work with the SOCAT dataset in LAS around the time of the Coastal meeting in January in Kiel. *(Responsible: Maria Hood. Timeframe: Immediate. Financial Implication: Medium).*

Action Item 8. Investigate the feasibility of having a meeting for the Pacific group to work with the SOCAT dataset in LAS in March following the intercomparison experiment in Tsukuba. *(Responsible: Maria Hood / Yukihiro Nojiri. Timeframe: Immediate. Financial Implication: Medium).*

Action Item 9. IOCCP should send a summary of co-sponsored activities to SIC and request that SIC provide information about their commitment to co-sponsorship and how they envision future interactions with IOCCP given the current state of the SIC. *(Responsible: Maria Hood. Timeframe: Immediate. Financial Implications: none).*

Action Item 10. Review the CBD database and suggest names of expert reviewers for the CBD synthesis. *(Responsible: Maria Hood to send to all SSG members. Timeframe: Immediate. Financial Implications: none).*

Action Item 11. Initiate the development of a summary for policymakers on ocean fertilization, and a new version of the Watching Brief. *(Responsible: Maria Hood and Ed Urban. Timeframe: Immediate. Financial Implications: low).*

Action Item 12. IOCCP should coordinated the development of 3 white papers for OceanObs09; 1) Repeat Hydrography, led by GO-SHIP; 2) Time Series led by

OceanSITES with Sabine and Gonzalez leading for IOCCP; and 3) Carbon VOS led by IOCCP, with Schuster, Monteiro, Bakker, Nojiri leading for IOCCP. (*Responsible: Maria Hood and Chris Sabine to coordinate / initiate actions; Timeframe: immediate. Financial Implication: none*).

Action Item 13. IOCCP should request that the GSSC add a slot for a ocean carbon / acidification expert on their committee. (*Responsible: Maria Hood and Chris Sabine; Timeframe: immediate. Financial Implication: none*).

ANNEX I

LIST OF PARTICIPANTS

<p>Dorothee Bakker School of Environmental Sciences University of East Anglia, UK Email: D.Bakker@uea.ac.uk</p>	<p>Maria Hood (<i>Secretariat</i>) UNESCO-IOC Email: m.hood@unesco.org</p>
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ANNEX II

AGENDA

DAY 1	SESSION I: OPENING AND PROGRAM AREA REVIEW
0900-0930	Opening, Welcome, and Introductions of the 2008-2010 SSG
0930-0950	Decadal Carbon Inventories and Repeat Hydrography
0950-1010	Ocean Interior Data Syntheses
1010-1030	Surface CO ₂ Data Synthesis Work
1030-1100	<i>Coffee Break</i>
1100-1120	Surface Flux Maps and Data Assimilation
1120-1140	Time Series
1140-1200	Underway pCO ₂ Networks
1200-1220	Integrated Greenhouse Gas Monitoring Networks
1220 - 1240	Data Management Update
1240-1400	<i>Lunch</i>
	SESSION II: REVIEW OF MAJOR ACTIVITIES
1400-1430	GO-SHIP
1430-1500	SOCAT Update
1500 - 1530	Time Series Network
1530-1600	<i>Coffee Break</i>
	SESSION III: REVIEW OF ACTIVITIES REQUIRING DECISION ABOUT FOLLOW-UP
1600 - 1630	Sensor Meeting / Directory Update
1630 - 1700	Southern Ocean Observing System strategy
1700 - 1730	EU Projects: <ul style="list-style-type: none"> • Coordinated Action Carbon Observing System (EU COCOS) • EPOCA training workshop / fundamentals of biogeochemistry
1730	Close of Day 1 / Group Dinner

DAY 2	SESSION IV: NEW ISSUES FOR CONSIDERATION
0900-0930	SOLAS – IMBER Carbon Group Review
0930-1000	UN interagency group on ocean fertilization
1000-1030	Standards for Ocean Acidification Research and Data Reporting
1030-1100	<i>Coffee Break</i>
1100-1115	Co-sponsorship of INSS group
1115-1130	OceanObs09 Conference
1130-1200	Direct Reporting to GSSC of GOOS
	SESSION V: PROJECT OFFICE ISSUES AND BUDGET
1200-1215	Hiring of new Director for IOCCP / Staffing for 2009+
1215-1230	Budget Review / Action Item List and Financial Implications
1230	Close of Meeting

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (**Also printed in Spanish**)
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping (**Also printed in French and Spanish**)
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica (**Spanish only**)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources (**Also printed in French and Spanish**)
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (**Also printed in French**)
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (**Also printed in Spanish**)
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (**Also printed in Spanish**)
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. Cancelled
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic (**Also printed in French**)
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (**Also printed in Spanish**)
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications

60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Inter-calibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans (**Also printed in French**)
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (**Spanish only**)
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (**Also printed in Spanish**)
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" (**Spanish only**)
115. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic (**Also printed in French**)
116. Tenth Session of the Officers Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
119. First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997
121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997

122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997
123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997
124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996
(also printed in Spanish)
125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997
126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997
127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998
128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997
129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997
130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998
131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997
132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997
133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998
134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997
135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998
136. Seventh Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Germany, 1997
137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998
138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998
139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998
140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998
141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 **(Spanish only)**
142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998
143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998
144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999
145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999
146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999
147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999
148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999
149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999
150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999
151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999
152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999
153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999
154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998
IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998
155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999
156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 **(also printed in Spanish and French)**
157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999
158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999
159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999
160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000
161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000
162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000
163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000
164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000
165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 **(also printed in Spanish and French)**
166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000
167. First GOOS Users' Forum, 2000
168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001
169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 **(also printed in French)**
170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001
171. First Session of the IOC-SCOR Ocean CO₂ Advisory Panel, France, 2000
172. Fifth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Norway, 2000 **(electronic copy only)**
173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 **(also printed in Spanish and French)**
174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001
175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001
176. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000
177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 **(also printed in French)**
178. Sixth Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Australia, 2001 **(electronic copy only)**
179. *Cancelled*

180. Second Session of the IOC-SCOR Ocean CO₂ Advisory Panel, Honolulu, Hawaii, U.S.A, 2002 (*electronic copy only*)
181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 2001 (SEAGOOS preparatory workshop) (*electronic copy only*)
182. First Session of the IODE Steering Group for the Resource Kit, USA, 19–21 March 2001
183. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002
184. Seventh Session of the IODE Group of Experts on Marine Information Management (GEMIM), France, 2002 (*electronic copy only*)
185. Sixth Session of IOC/WESTPAC Coordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2001 (*electronic copy only*)
186. First Session of the Global Ocean Observing System (GOOS) Capacity Building Panel, Switzerland, 2002 (*electronic copy only*)
187. Fourth Session of the ad hoc Advisory Group for IOCARIBE-GOOS, 2002, Mexico (*also printed in French and Spanish*)
188. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IBCWIO), Mauritius, 2000
189. Third session of the Editorial Board for the International Bathymetric Chart of the Western Pacific, Chine, 2000
190. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002
191. Eighth Session of the IOC Consultative Group on Ocean Mapping, Russian Federation, 2001
192. Third Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Lisbon, 2003 (*also printed in French*)
193. Extraordinary Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Chile, 1999 (*Spanish only; electronic copy only*)
194. Fifth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, France, 2002
195. Sixth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, South Africa, 2003
196. Fourth Session of the Coastal Ocean Observations Panel, South Africa, 2002 (*electronic copy only*)
197. First Session of the JCOMM/IODE Expert Team On Data Management Practices, Belgium, 2003 (*also JCOMM Meeting Report No. 25*)
198. Fifth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2003
199. Ninth Session of the IOC Consultative Group on Ocean Mapping, Monaco, 2003 (*Recommendations in English, French, Russian and Spanish included*)
200. Eighth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2003 (*electronic copy only*)
201. Fourth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Greece, 2004 (*also printed in French*)
202. Sixth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2004 (*electronic copy only*)
203. Fifth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Argentina, 2005 (*also printed in French*)
204. Ninth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2005 (*electronic copy only*)
205. Eighth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), China, 2003 (*electronic copy only*)
206. Sixth Meeting of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Spain, 2006 (*also printed in French*)
207. Third Session of the Regional Forum of the Global Ocean Observing System, South Africa, 2006 (*electronic copy only*)
208. Seventh Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2005 (*electronic copy only*)
209. Eighth Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2006 (*electronic copy only*)
210. Seventh Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Gabon, 2007 (*bilingual English/French*)
211. First Meeting of the IOC Working Group on the Future of IOC, Paris, 2008 (*Executive Summary in English, French, Russian and Spanish included*)
212. First meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 3–4 April 2008 (*Executive Summary in English, French, Russian and Spanish included*)
213. First Session of the Panel for Integrated Coastal Observation (PICO-I), Paris, 10–11 April 2008 (*electronic copy only*)
214. Tenth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 6–8 June 2007 (*electronic copy only*)
215. Eighth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 21–25 April 2008 (*bilingual English/French*)
216. Fourth Session of the Global Ocean Observing System (GOOS) Regional Alliances Forum (GRF), Guayaquil, Ecuador, 25–27 November 2008 (*electronic copy only*)
217. Second Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 27 March 2009 (*Executive Summary in English, French, Russian and Spanish included*)
218. Ninth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 30 March–3 April 2009 (*bilingual English/French*)
219. First Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 3), Broomfield, Colorado, U.S.A., 1 October 2005 (*electronic copy only*)
220. Second Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 6), Paris, France, 20 April 2007 (*electronic copy only*)
221. Third Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 10), Villefranche-sur-mer, France, 3–4 October 2008 (*electronic copy only*)