



REPORT

Eighth Session of the Scientific Steering Group

22-23 April 2013
Norwich, UK



United Nations
Educational, Scientific and
Cultural Organization



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Oceanographic
Commission



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SSG for 2013 and Participants List

The composition of the IOCCP SSG in 2013 is shown Table 1 below. This table also acts as a participants' list as far as SSG members are concerned. Contact details and full affiliations of listed SSG members can be found on the IOCCP website (Contacts' tab). Additional participants are listed in Table 2.

Table 1. SSG members for 2013

Name (Gender)	Home Institution	Country of residence	Expertize	Participation in the Eighth Session of the IOCCP SSG
Tanhua Toste (M)(Chair)	GEOMAR	Germany	Ocean Interior Measurements	Participated
Aoyama Michio (M)	JMA-MRI	Japan	Nutrients	Participated
Feely Richard (M)	NOAA-PMEL	USA	Ocean Acidification	Participated
Ishii Masao (M)	JMA-MRI	Japan	Ocean Interior Synthesis	Not Present
Kozyr Alexander (M)	CDIAC	USA	Data Management	Participated
Lorenzoni Laura (F)	USF	USA	Time Series	Participated
Martz Todd (M)	SIO	USA	Instruments and Sensors	Not Present Joined by Skype
Olsen Are (M)	UB	Norway	Ocean Surface Synthesis	Participated
Pfeil Benjamin (M)	UB	Norway	Data Management	Participated
Schuster Ute (F)	UEA	UK	Flux Maps/Data Assimilation	Participated
Sloyan Bernadette (F)	CSIRO	Australia	Repeat Hydrography	Not Present
Maciej Telszewski (M)	IOCCP	Poland	Project Director	Participated

Table 2. Representatives of partner projects and organizations

Name (Gender)	Home institution	Country of residence	Role	Participation in the Eighth Session of the IOCCP SSG
Corinne Le Quere (F)	Tyndall-UEA	UK	Global Carbon Project, Co-chair of the GCP SSC	Participated (partly)
Antonio Bombelli (M)	UT	Italy	EU FP7 GEOCARBON Project, Project Manager	Joined by Skype
Heather Benway (F)	OCB	USA	U.S. Ocean Carbon and Biogeochemistry Project, Executive Officer	Joined by Skype
Nicolas Gruber (M)	ETH	Switzerland	SIC WG2 Chair	Not Participated
Andrew Lenton (M)	CSIRO	Australia	SIC WG1 Chair	Not participated

Report

1. Introduction

The Eighth Session of the IOCCP Scientific Steering Group was held 22-23 April 2013 at the University of East Anglia in Norwich, United Kingdom. As agreed during the Seventh Session, the meeting was held in conjunction with another international meeting (in this case the EU FP7 IP CARBOCHANGE Annual Meeting) attended by several SSG members hence reducing travel and increasing cost-effectiveness. Toste Tanhua (Chair) was joined by seven members of the SSG and the Project Director. Three SSG members could not attend the meeting; one joined by Skype (see Table 1). One representative of partner projects and organizations attended parts of the meeting in person and two additional representatives joined the meeting by Skype (see Table 2).

Toste Tanhua welcomed the SSG members to the 2013 meeting and thanked the local organizer (Ute Schuster) for the time and effort spent on preparations to the meeting. He then welcomed new members Michio Aoyama and Richard Feely and thanked Jean-Pierre Gattuso, Pedro Monteiro and Yukihiro Nojiri who rotated off after 6 years of dedicated service to the IOCCP.

Tanhua provided a brief overview of the many on-going activities that IOCCP got involved in over the previous 10 months (since the Seventh Session). He recalled the SSG Quarterly Virtual Meetings (teleconferences) as important tool for the members to coordinate activities in short term and hinted that in-person meetings should concentrate primarily on long term planning and developing/shaping the long term strategy for the community.

Finally he reminded the SSG that IOCCP started its shift to help the community to coordinate carbon-related biogeochemical parameters beyond inorganic carbon. Tanhua provided a brief introduction specifically outlining IOCCP's role in the Framework for Ocean Observing. He also highlighted the need for IOCCP to follow a general move of the community from activities primarily focused on inorganic carbon to activities motivated by the need to answer more complex questions related to changes in marine biogeochemistry and climate; these changes are presumably triggered by pressures exerted by multiple stressors, which can result in changes in oxygen distribution and nutrient availability.

This report summarizes the presentations and discussions held during the meeting. It does not necessarily follow the chronological order depicted in the meeting agenda but tries to divide the information provided during the meeting into subject-related chapters to enable a better implementation of the action items stemming from the meeting.

2. Update and Vision for Underway CO₂ Observations

Ute Schuster presented the recent developments related to collection, assimilation and interpretation of underway pCO₂ data, especially the wide involvement of underway data collecting community in the REgional Carbon Cycle Assessment and Processes ([RECCAP](#)). During this project, many members of the global surface observational community have actively been involved in the quality control of data added to SOCATv2 (section 2), that had not been in SOCATv1.5 or been updated since then. She also presented recently published surface pH climatology and asked for it to be distributed for the benefit of a wider community. Schuster highlighted two important upcoming meetings, the 9th International Carbon Dioxide Conference to be held in Beijing, China, 2-7 June 2013 (ICDC9) and the 2nd Workshop on the Global Ocean Acidification Observing Network to be held in St. Andrews, Scotland, 24-26 July 2013 (GOA-ON 2). Both these events require IOCCP's support and details are described in section 3 and section 7 of this report respectively.

Discussion initially focused on the decreasing status quo on the coverage of measurements on Voluntary Observing Ships (VOS). Richard Feely reported that the US VOS programs are constantly set-back by shipping companies changing their routes and/or vessels without much (if any) warning, mirrored by experiences in VOS programs of other nations. The shipping industry is adjusting to ever-stronger competition in a sluggish global economy by frequently changing routes and ships to optimize cargo volume transported per distance, hence keeping/reducing costs; such sudden changes to ships' operations impact data collectors both financially as well as in the form of extended temporal and spatial data gaps. The future development of this is dependent on the global economy and therefore uncertain.

Are Olsen suggested that it is perhaps reasonable to evaluate the use of gliders and wave-gliders as replacement for ships in some areas, such as those expected to be changing most quickly and substantially in carbon content. A general conclusion was reached that it is still very early in the platform and sensor development cycle for the robotic technologies to replace ships. The quality of sensor measurements needs to improve and the gliders themselves are very labor intensive (need to be piloted 24/7). Also too few long-term expeditions testing various aspects of their operation was conducted to date.

The discussion was then centered on various aspects of the subject-specific page of the IOCCP website. It was suggested that, staff-time allowing, the page should include more information and advice on setting up and running of pCO₂ systems as well as a list of experienced users of pCO₂ systems able to give advice. Finally, again staff-time allowing, the VOS maps on the website should be updated at least annually and perhaps could be more interactive and informative.

ACTION ITEM 1

Distribute the information about the pH climatology. (*Responsible: Telszewski. Timeframe: Boreal Summer 2013. Financial Implications: None*)

ACTION ITEM 2

Work on the IOCCP's Underway webpages to include more information and advice on setting up and running pCO₂ systems onboard ships, as well as a list of

experienced users of pCO₂ systems able to give advice. (*Responsible: Telszewski, Schuster. Timeframe: Boreal Spring 2014. Financial Implications: None*).

ACTION ITEM 3

Update the VOS maps on the website regularly and make them more informative. Coordination with regional programmes is required. A European observational network co-ordination position, part of the EU FP7 IP project CARBOCHANGE will be advertised in August 2013 by the University of Exeter, UK. This person will take on the role for the European VOS network aiming, inter alia, at incorporating ongoing European activities and future plans into the global community's schedule (*Responsible: Telszewski, Schuster, Tanhua. Timeframe: Boreal Spring 2014 and ongoing. Financial Implications: None*).

3. Update and Vision for Synthesis Activities: Surface Ocean

Are Olsen presented this theme. The IOCCP activity on surface ocean synthesis in this reporting period has focused on the Surface Ocean CO₂ Atlas ([SOCAT](#)). This is the major global community effort focusing on surface ocean CO₂ data. The data product was first released in September 2011, and has since then been broadly used by marine biogeochemists.

Over this reporting period the SOCAT community has been finalizing preparations for the second version of the Surface Ocean CO₂ Atlas, while at the same time laying the foundations for future and more streamlined SOCAT releases.

The following meetings have been co-organized and to a large extent sponsored by the IOCCP:

- The SOCAT Automation Meeting held in Seattle, USA, 10-11 May 2012. This meeting laid out clear plans and responsibilities for the work towards the SOCAT automated data submission system. The full meeting report is available [here](#) and from the SOCAT website.
- Planning meeting for quality controlling SOCAT version 2 held in Tsukuba, Japan, 3-5 July, 2012. This meeting gathered 21 scientists from 7 different countries. Several issues were dealt with, for instance: setting the agenda and time line for the preparation for version 2 release, planning for the automated data submission system, and inclusion of data from non-conventional CO₂ sensors mounted on moorings, drifting buoys and similar platforms. The full report is available [here](#) and from the SOCAT website.
- The SOCAT Coastal and Arctic quality control workshop held in Seattle, USA, 2-4 October 2012. The workshop was chaired by Maciej Telszewski (IOCCP) and Simone Alin (NOAA-PMEL) and attended by 18 scientists from four countries. During the meeting the QC group was familiarized with the QC criteria and received hands-on training with the SOCAT Live Access Server QC system. Responsibilities for QC were defined and actual QC was carried out. After the meeting all but 9 (of 894 prior to the meetings) cruises had been

QC'ed by the coastal group volunteers. The full meeting report is available [here](#) and from the SOCAT website.

The SOCAT community has further organized itself through various teleconferences and active email exchange, in large part due to the excellent leadership of Dr. Dorothee Bakker (Chair of SOCAT Global Group, UEA, UK).

In addition, IOCCP sponsored the visit (10-12 February 2013) of Pfeil to the LAS-developing group in NOAA/PMEL labs in Seattle, USA, to allow for the resolution of remaining outstanding technical issues regarding the preparations of SOCAT version 2 (v2) public release. SOCAT v2, which has been completed over the reporting period, includes 10 million surface ocean $f\text{CO}_2$ data points, in a uniform format and fully quality-controlled database. This is 4 million data points more than SOCAT v1.5, released in 2011. Most of these data are from the years 2008 through 2011. SOCATv2 will be released at an IOCCP-sponsored side event at the International Carbon Dioxide Conference in June 2013 (Beijing, China). SOCAT will thus continue to be a huge resource for the carbon research community.

In addition, efforts towards getting the automated data submission system operational are well underway. This will be hosted by the LAS group at NOAA/PMEL. Users will be able to submit their data and meta-data through an online data portal. During the process, QC will be carried out, including checking whether the data are fully documented. We expect that the system will be ready for testing late 2013. An additional technical meeting of software developers will be held in late 2013 or early 2014. Finally we would like to mention that preparations for SOCAT version 3 have already started, and several new cruises have been added to the database.

ACTION ITEM 4

Organize and implement the SOCATv2 release side-event at the ICDC9. *(Responsible: Telszewski, Olsen. Timeframe: June 2013. Financial Implications: Low)*

ACTION ITEM 5

Financially support SOCAT Automation meeting. *(Responsible: Telszewski. Timeframe: Boreal Fall 2013 – Boreal Winter 2013/2014. Financial Implications: Low)*

ACTION ITEM 6

Continue supporting SOCAT technical development by information distribution, facilitating virtual meetings and supporting report writing. *(Responsible: Telszewski, Olsen, Pfeil. Timeframe: on-going. Financial Implications: None)*

4. Update and Vision for Ocean Interior Observations

Bernadette Sloyan could not attend the meeting and provided her input for Tanhua to present. A global reoccupation of the GO-SHIP hydrographic sections was recently completed. The global reoccupation was completed in a 10-year timeframe beginning in the Atlantic Ocean in 2003 and finishing in 2013 with the completion of the high latitude Southern Ocean Indian section (S04I and P14S). With that, the international community is now planning the next decade of global repeat. Richard Feely strongly suggested that IOCCP keeps being involved in coordination of global repeat

hydrography at a planning and negotiating level. A town-hall session at the Ocean Sciences Meeting in 2014 is considered and Feely suggested that IOCCP should support it. The panel agreed.

Also, with the completion of the global survey, the GO-SHIP committee is now working with CCHDO to undertake an audit of repeat sections completed and data availability at CCHDO. This is coordinated by Sloyan and Steve Diggs (CCHDO).

The GO-SHIP committee held a number of teleconference meetings in 2012, mainly organized by Maciej Telszewski, who provided valuable help to the GO-SHIP committee. Much of these discussions centered on completion of the program plan and defining the role of and funding sources for a GO-SHIP-dedicated coordinator. Over the past 3 years, GO-SHIP has demonstrated that without global coordination for planning and implementation of sections, significant gaps and duplications arise, and most sections do not measure the full suite of core variables. A program coordinator is needed to provide international coordination and implementation. Working with an international scientific steering committee, the program coordinator would be responsible for facilitating data release and sharing, and data management; facilitating collaborations to ensure that the full suite of core variables are measured on each cruise; providing technical support for meetings of the scientific steering committee; working with the other observing system components to harmonize and integrate observations and data streams; and serving as a central communications and information forum for the hydrographic community.

In parallel to the above discussions, Matthieu Belbeoch (JCOMMOPS) was actively pursuing the JCOMMOPS's Ship Coordinator position. The GO-SHIP committee met in late 2012 to discuss the option of the JCOMMOPS Ship Coordinator filling some GO-SHIP coordinator goals based on financial support for this position provided from the GO-SHIP community. Consequently, the GO-SHIP committee, via Bernadette Sloyan, worked with Belbeoch and others to update the position description, and interview for recruitment of the Ship Coordinator. This process was concluded with Martin Kramp taking up the position on 4 February 2013.

As for non-GO-SHIP cruises, discussion developed around the need for a more active approach by IOCCP. We need to provide scientists with a platform to share information about their planned activities, needs and opportunities for collaboration. Also data and metadata related to their activities should be harvested more effectively for submission to CDIAC and CCHDO. An online form will be developed by Pfeil and promoted by Telszewski, allowing for basic information sharing amongst the community.

Additionally, the map of planned and completed repeat hydrography cruises needs to be updated and made more interactive (a kmz layer for Google Earth, for example), with users directed to appropriate data centers for data and metadata.

ACTION ITEM 7

Coordinate GO-SHIP related information distribution and relevant web updates with Martin Kramp (JCOMMOPS) and Lynne Talley and Steve Diggs (both CCHDO). *(Responsible: Telszewski, Sloyan. Timeframe: on-going. Financial Implications: None)*

ACTION ITEM 8

Develop an interactive online form and update the website as needed in order to promote data and information sharing for non-GO-SHIP hydrography efforts. (*Responsible: Telszewski, Pfeil. Timeframe: ongoing. Financial Implications: None.*)

ACTION ITEM 9

Develop a clickable map of planned and completed repeat hydrography cruises (for example a kmz layer for Google Earth) with users directed to appropriate data centers for data and metadata. (*Responsible: Pfeil. Timeframe: Boreal Spring 2014. Financial Implications: None.*)

ACTION ITEM 10

Co-host and support a repeat hydrography session at the Ocean Sciences Meeting 2014. (*Responsible: Feely, Sloyan, Telszewski. Timeframe: February 2014. Financial Implications: Low*)

5. Update and Vision for Synthesis Activities: Ocean Interior

Tanhua and Olsen presented this theme for Ishii who could not attend the meeting. The Global Ocean Data Analysis Product version 2 (GLODAPv2) is currently being assembled by the key members of the international marine CO₂ community. The group of 10 scientists met at the Institute of Marine Research, Bergen, Norway, 12-14 November 2012 for a workshop sponsored by the IOCCP, the Fram – High North Research Centre for Climate and the Environment and the Bjerknes Centre for Climate Research, University of Bergen.

This new global carbon data product aims at assembling all the existing interior ocean carbon data synthesis products into one harmonized data package. Specifically, the group is including the data from CARINA, GLODAP v1.1 and PACIFICA, and they will also add data from about one hundred "new" cruises to this collection.

The key step in the approach is an extensive analysis of the quality and consistence of the available data. Among other things, this requires reassessing the adjustments derived for the GLODAPv1.1 product, primarily in order to harmonise conventions for bias correction of nutrients and oxygen, but also performing more effective crossover identification following the development of relevant software. In addition, consistency analysis of CFC data from the Atlantic and Indian oceans included in GLODAPv1.1 was required.

The majority of this work had been carried out in the months leading up to the workshop and the time at the workshop was largely dedicated to agreeing or discarding suggested bias adjustments, settling on the final format of the product and planning the details of GLODAPv2 schedule. GLODAPv2 will likely be ready late in 2013 and it is foreseen that it will evolve into a routine effort, with regular releases of updated versions in the future.

IOCCP also partially covered the cost of SSG member Alex Kozyr participating in the GLODAPv2 secondary quality control (QC) Toolbox training course, which was held

in the Eidgenössische Technische Hochschule (ETH) in Zürich, Switzerland on 25-28 February 2013. As the future updates to the GLODAP data set, including the QC of new data, are planned to be performed at the Carbon Dioxide Information Analysis Center (CDIAC), the IOCCP found it very important to help Kozyr obtain the relevant expertise.

One more technical meeting of core GLODAPv2 developers might be necessary before the public release of the data set.

ACTION ITEM 11

Continue promoting GLODAPv2 efforts. Support (including financially) coordination efforts leading to the release of the GLODAPv2 data set. (*Responsible: Telszewski, Ishii. Timeframe: ongoing. Financial Implications: None to Low*).

6. Update and Vision for Time Series Efforts

Laura Lorenzoni reported on current and planned Time Series (TS) activities involving the IOCCP. After the successful November 2012 international time-series methods workshop: *Global Intercomparability in a Changing Ocean*, a draft report has been compiled by IOCCP (Lorenzoni) and U.S. OCB (Heather Benway); Feedback was received from ~50% of the scientific steering committee/working group leads and their comments were integrated into the final version of the report which was completed and published in June 2013. In the meantime, summaries of workshop results have been featured in *Eos*, the *IOCCP Conveyor*, and a summary of results will also be presented (Benway) at this summer's OCB workshop in July 2013.

The collection of information from ship-based TS is still ongoing, and this is happening with the help of colleagues from the Intergovernmental Oceanographic Commission (IOC, Kirsten Isensee and Luis Valdes). The workshop website will morph into a permanent portal for ship-based biogeochemical TS where detailed information about biogeochemical time-series will be available, including contact information, mailing lists, capacity building opportunities and other resources for time-series sites. We expect the site to be ready together with the report, by the end of May. Todd O'Brien (US NOAA) has offered to help create an interactive map for IOCCP's and OCB's TS site.

With regards to the IOCCP TS page, it is currently being populated and updated. We will maintain both biogeochemically-related moorings and ship-based TS, but will try to make the links interactive so that they can direct the user to constantly updated spreadsheets of information and/or links to TS home sites/other relevant resources.

Future TS IOCCP activities:

May 2013: IOCCP will participate in the steering committee meeting of OceanSITES (Seoul); the objective of our participation is to enhance the coordination of biogeochemical time-series work between OceanSITES and IOCCP. Specifically, IOCCP is interested in the discussions of the first item on the OceanSITES meeting's agenda: "Re-evaluate definition (scope) of the OceanSITES project and

characteristics of sites in the system (one goal is endorsement of the new How-To document by the SC). Reconfirm and clarify prior discussions/decisions about narrowed focus of OceanSITES (what kind of sites and data are included/hosted).”

February 2014: IOCCP, together with OCB, has proposed a session at the 2014 Ocean Sciences meeting: “Global inter-comparability in a changing ocean: The growing importance of ship-based biogeochemical time-series”. This session aims at gathering contributions from studies, which use time-series data, particularly those that interconnect time-series sites. It also encourages presentations on insights gained from methodological challenges encountered when comparing data from two or more time-series and methodological experiments or intercomparison activities that could improve biogeochemical sampling and analytical protocols.

Several recommendations on activities (workshops/intercomparison exercises) emerged from the November 2012 workshop. Depending on the funding available, in 2014 and 2015 there will be a follow-up workshop, which may be focused on specific method(s) or other key issues identified by the TS community. This workshop will be coordinated with relevant collaborating organizations (e.g. US OCB, IOC, OceanSITES, etc.). There is also the necessity to identify other needs/directions that IOCCP could help time-series sites.

Are Olsen asked whether the time series community plans on compiling a synthesis product similar to SOCAT or GLODAP. Lorenzoni expressed her concerns related to the readiness of TS community to share its data in one central repository. Richard Feely suggested that the IOCCP should encourage the TS community to re-asses its data-sharing attitudes. His concerns stem from several meetings with program managers at various funding agencies, during which he was made aware that less and less financial support would be given to projects that do not have a clear and transparent data sharing policy. Benjamin Pfeil suggested that developing an offline data archive to attract the attention of the TS community might be an effective first step.

ACTION ITEM 12

Participate in the OceanSITES Steering Committee Meeting 2013. (*Responsible: Lorenzoni. Timeframe: May 2013. Financial Implications: Low*)

ACTION ITEM 13

Help the community to develop and promote a transparent data sharing policy. Funding agencies are becoming ever-more reluctant to support activities that do not result in publicly sharing the data obtained through publicly funded science activities (*Responsible: SSG. Timeframe: ongoing. Financial Implications: None*).

ACTION ITEM 14

Develop a prototype offline data depository for TS data to share with data providers as a first step to what might become a global TS data archive (*Responsible: Pfeil, Kozyr, Lorenzoni. Timeframe: ongoing. Financial Implications: None*).

ACTION ITEM 15

Co-host (with US OCB) and support a time series related session at the Ocean Sciences Meeting 2014. (*Responsible: Lorenzoni, Telszewski. Timeframe: February 2014. Financial Implications: Low*)

7. Update and Vision for Ocean Acidification

Richard Feely reported on ocean acidification (OA) activities related to IOCCP. Over the last year it became clear that the IOCCP has a strong role to play in the OA community. As a primary international entity coordinating observations and data streams related to marine carbon cycle, the IOCCP is superbly positioned to lead the global OA observing community in its urgent efforts to design and implement a globally coherent OA monitoring network. The IOCCP will work (and indeed has already started working) with the Global Ocean Observing System Steering Committee and the International Coordination Center for Ocean Acidification as well as with national OA programs and OA funding agencies to develop the requirements, procedures, standards and routes for communication to achieve this goal most effectively.

In June 2012, 62 scientists from 23 countries assembled at the University of Washington (UW) in Seattle to discuss the form and function of a global network for monitoring ocean acidification and its effects on biological systems. The 3-day workshop (Global Ocean Acidification Observing Network, GOA-ON) was sponsored by NOAA, IOC, IOCCP, GOOS, IOOS and UW.

The principal goals of this international workshop were to (1) provide the rationale and design of the components and locations of an international carbon and ocean acidification observing network that includes repeat hydrographic surveys, underway measurements on VOS, moorings, floats and gliders taking into account existing networks and programs wherever possible; (2) identify a minimum suite of parameters to measure and performance metrics for each major component of the observing system; (3) develop a strategy for data quality assurance and data distribution; and (4) discuss requirements for program integration at the international level.

Participants identified that the goals of the network are to provide:

(1) An understanding of global OA conditions: Identify spatial/temporal patterns and assess generality of response; document and assess variation to infer mechanisms driving condition; quantify rate of change and ID areas of vulnerability; (2) An understanding of ecosystem response to OA: Measure biological responses to physical / chemical changes; quantify rate of change and ID areas of vulnerability; and (3) Input data to optimize modeling for OA: Provide spatially and temporally resolved data for initial conditions and evaluation of models; then use model outputs to aid the interpretation of goals 1 and 2.

Network goals are to provide globally distributed high-quality data, near real-time data, and data synthesis products that facilitate new research on OA, communicate status of OA and biological response and enable forecasting/prediction of OA conditions. A workshop report, under preparation, will provide not only these details, but will serve as a consensus approach on the strategy needed to construct a suitable global OA observing system for review and, hopefully support by national funding agencies concerned with OA. The full report is anticipated by June 2013. For details, see <http://www.pmel.noaa.gov/co2/OA2012Workshop/>.

The sponsors of the GOA-ON meeting and other organizations with interests have agreed that a 2nd workshop is needed to build on the progress made in establishing an international framework for global scientific collaboration in this important area. The 2nd GOA-ON Workshop (GOA-ON 2) will be held at the University of St Andrews, Scotland, UK on 24-26 July 2013. The workshop will continue the activities initiated in Seattle, progressing the design of the components and locations of a global OA observing network; identifying measurement parameters and procedures for major components; and developing the strategy for data management. Aspects to be given particular attention include (i) improving the comparability of coastal/shelf sea OA observations; (ii) bringing together national and regional components into a globally coherent whole; (iii) linking with on-going time series and biological monitoring; and (iv) the synthesis of existing data (subject to quality control). The workshop will include overview presentations, plenary and break-out discussion sessions, and posters.

The recommendations of the first and the second workshop will be supported and promoted by the IOCCP. Both meetings will have been well attended by the IOCCP SSG members, whose active participation will have allowed for workshops' outcomes to be aligned with IOCCP's work plan.

ACTION ITEM 16

Co-organize, co-sponsor and participate in the 2nd GOA-ON workshop in St. Andrews, Scotland. (*Responsible: Feely, Schuster and Telszewski. Timeframe: July 2013. Financial Implications: Medium to High*)

ACTION ITEM 17

Distribute and promote outcomes from both GOA-ON workshops including permanent website updates and presentations during related national and international meetings (*Responsible: SSG. Timeframe: Ongoing. Financial Implications: None*).

ACTION ITEM 18

Work closely with GOOS, ICC-OA and national OA programs and OA funding agencies to implement elements of the global ocean acidification monitoring network. (*Responsible: Feely, Telszewski, SSG. Timeframe: ongoing. Financial Implications: None*).

8. Update and Vision for Nutrients

Michio Aoyama presented the current status of nutrients observing system. He concentrated mainly on results of inter-comparability of measurements and development of certified reference material for nutrients. Changes in distribution and concentration of dissolved nutrients are an important part of many global geochemical cycles. In order to be able to observe these changes with required precision and accuracy, the community needs to be able to reliably compare their results with confidence. However, there are no existing standard reference materials allowing equipment calibration so that nutrient data can be compared globally. There is a strong requirement for the laboratories around the globe involved in measurements of nutrients to harmonize their analyses.

Despite the numerous inter-laboratory comparison studies that have been carried out since 1965 to improve comparability of nutrients data in the world oceans (UNESCO, 1965, 1967; ICES 1967, 1977; Kirkwood, 1991, Aminot et al., 1995; Topping, 1997; Willie and Clancy, 2000; Clancy and Willie, 2003; Aoyama et al., 2006, 2008, 2010, 2013) no consensus has been reached to date. The 4th IPCC Assessment Report in 2007 highlighted this problem inherent in comparing existing data sets: "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).

To guarantee comparability of data from different laboratories and from different research cruises, globally accepted reference materials (RMs), certified reference materials (CRMs) and standard operating procedures (SOP) for nutrients measurements need to be further developed. Marine chemists therefore have been active in the pursuit to establish reliable comparability of nutrient measurements. A consensus has been achieved through former IOC-ICES Study Group On Nutrient Standards (SGONS) activity in realizing (i) the limits imposed on the work by impurities in "off-the-shelf" chemicals, (ii) the form that reference materials should take, (iii) the quantities that they would need to be produced in, and (iv) that the use of CRMs needs to be done in accordance to SOPs.

Further international collaboration and action is now required to harmonize oceanic nutrient data using globally accepted RMs/CRMs. Particularly important issues for the study of changes in properties of deep water masses is to develop a system by which the data is comparable within and between laboratories at the 0.1% level. This goal should apply both within individual cruises and extend to comparisons between cruises separated by decades. The IOCCP, in strong collaboration with institutional and programmatic partners worldwide, is going to work toward the development of such a system to harmonize global oceanic nutrient analyses.

ACTION ITEM 19

Work with the community to improve nutrient measurement methods and develop internationally accepted agreement on a nutrient certified reference material to enable intra- and inter-laboratory data comparisons to within 0.1%. Support an inter-comparison experiment if necessary (*Responsible: Aoyama. Timeframe: Early 2014. Financial Implications: Medium*)

ACTION ITEM 20

Work with the nutrient community to update existing documents describing operating procedures, including the GO-SHIP manual (*Responsible: Aoyama. Timeframe: Early 2014. Financial Implications: None*)

ACTION ITEM 21

Host and support a nutrient-related session at the Ocean Sciences Meeting 2014 (*Responsible: Aoyama, Telszewski. Timeframe: February 2014. Financial Implications: Low*)

9. Update and Vision for Instruments and Sensors

Todd Martz updated the group on this subject. He focused mainly on specifying how IOCCP could improve the quality of data obtained by autonomous sensors.

IOCCP maintains a comprehensive directory of commercially available technologies to measure ocean inorganic carbon, which can be broadly categorized as bench top/underway instruments and autonomous sensors. Calibration, standardization and quality control of measurements made on the bench top/underway systems are relatively mature and traceable to standard gases or CRMs. A multitude of inter-comparison experiments, fostered by UNESCO, IOCCP and other coordinating organizations, have been carried out for these instruments over the past several decades in order to bracket measurement errors for data reporting. In contrast, none of the autonomous sensors listed on the IOCCP website would meet the quality management requirements set for the bench top/underway systems or other environmental fields of study involved in generating “climate-quality” data. The remote location of autonomous sensor deployments makes this undertaking one of the great challenges in modern oceanography. Consequently, data generated by in situ sensors are uploaded into databases such as BCO-DMO or CDIAC with insufficient validation.

To this end, two major inter-comparison efforts have been held for pCO₂ sensors. The first, co-sponsored by IOCCP, was held in Tsukuba, Japan (2003) in a test tank setting and the second was carried out by The Alliance for Coastal Technologies (ACT) at two coastal moorings (2009). No long-term open-open inter-comparison experiments have been conducted.

As carbon sensors mature, the need for frequent and systematic in situ inter-comparison experiments will sharply increase. Verification-Validation criteria need to be defined explicitly and associated with the various data quality levels defined in the metadata. Specifically the following actions would benefit from IOCCP’s involvement:

- Field-based inter-comparisons present a significant challenge and should be carefully planned with regularity and expert oversight for both coastal and open ocean locations. Controlled laboratory test tanks should be supported and coordinated by IOCCP
- Laboratory and field testing should be coordinated to complement each other, with a clear statement of the tradeoffs and limitations of each. For example, lab testing is ideal for verification of sensor dynamic range and establishing calibration protocols while field testing is necessary to reveal true performance under real environmental stresses that cannot be simulated in the laboratory. As demonstrated by the ACT pCO₂ sensor inter-comparison, attempting to carry out dynamic range or accuracy assessments in the field in the presence of biofouling and intense spatiotemporal gradients is often insurmountable. In these tests, the sensor errors of interest were largely dwarfed by bottle sampling errors, likely due to the choice to carry out the tests in highly dynamic coastal settings with large spatiotemporal gradients, yielding results of limited value.
- Un-validated in situ data are not necessarily low quality and should not be labeled at the same data quality level as data that are known to be bad. Yet, un-validated data must be identified as such in any database. Metadata

defining a validation level in addition to a quality level may be of some utility.

- The results of routine intercomparison experiments will inform the IOCCP recommendations for verification/validation. For example, if bottle samples cannot be satisfactorily spatiotemporally aligned with sensors, IOCCP may recommend that only in situ sensors with automated *in situ* validation systems would meet the highest validation quality level.

Due to the wide price range of in situ systems, IOCCP could perform a needed service by posting recent price quotations of each sensor listed in the online directory. Furthermore, the directory could be modified into a formal database listing many other features such as deployment duration, size, weight, and manufacturer specifications for accuracy, precision, response time, drift, etc.

As far as biogeochemistry sensors are concerned, a pH sensor development process is mature but other parameters are significantly behind. Sensor development should be promoted and IOCCP will encourage funding agencies to support sensor development activities.

ACTION ITEM 22

Work with the international community and specific sensor-developing institutions to organize a workshop to develop quality control and sensor calibration procedures and data quality control procedures for nutrients, carbon (including OA specific) and oxygen sensors. Workshop rationale, agenda and outcomes would be ideally developed in close collaboration with OceanSITES and US OCB. The main outcome should be a document for best practices for autonomous sensors measurements (*Responsible: Martz, Lorenzoni, Telszewski. Timeframe: Early 2014. Financial Implications: Medium to High*)

ACTION ITEM 23

Work with data synthesis groups to develop methodologies allowing data quality control of sensors data that takes into account limitations of sensors technology (*Responsible: Martz, Telszewski. Timeframe: Early 2014. Financial Implications: None*)

ACTION ITEM 24

Extend the functionality and content of the Instruments and Sensors' page on IOCCP website to better cater the community needs (*Responsible: Martz, Telszewski. Timeframe: On-going. Financial Implications: None*)

10. Update and Vision for Data and Information Management

Alex Kozyr provided a performance assessment of the Carbon Dioxide Information Analysis Center (CDIAC) since the previous SSG meeting.

- All 259 original PACIFICA cruise data files can be accessed via PACIFICA web site <http://cdiac.ornl.gov/oceans/PACIFICA/>.
- New LDEO V2011 database was published in August 2012.

- The new OME system for Mercury was implemented over the past year.

CDIAC continued to obtain and process ocean carbon data from numerous projects that include the following:

New data from International Repeat Sections Project:

1. OISO-12_2005 (France) – final and public online
2. OISO-17_2009 (France) – final and public online
3. OISO-18_2010 (France) - final and public online
4. I08_2007 (USA) – final and public online (complete data set)
5. I05_2009 (USA) – final and public online (complete data set)
6. ISSS_08 (Sweden/Russia) Arctic – final and public online
7. AR07E_2005 (Netherlands)- final and public online
8. A12_2002_ANTXX_2 (Germany) - final and public online
9. A12_2005_ANTXXII_3 (Germany) - final and public online
10. A12_2006_ANTXXIII_7 (Germany) - final and public online
11. A12_2007_ANTXXIV_2 (Germany) - final and public online
12. A12_2008_ANTXXIV_3 (Germany) - final and public online
13. A12_2010_ANTXXVII_2 (Germany/Netherlands) - final and public online
14. A12_2008_JC30_ANDREX-1 (UK) - final and public online
15. A12_2010_JR239_ANDREX-2 (UK) - final and public online
16. A13.5_2010 (USA) - final and public online
17. SR03_2008 (Australia) - final and public online
18. I09S_2004 (Australia) - final and public online
19. P09_2010 (Japan) - final and public online
20. P06_2009 (USA) - final and public online
21. A06_2010 (Spain) - final and public online
22. AR07W_2008 (UK) - final and public online
23. A20_2012 (USA) - final and public online except TCO2 data
24. A22_2012 (USA) - final and public online except TCO2 data
25. A10_2011 (USA) - final and public online
26. A9.5_2009 (UK) - final and public online
27. A21_2009_JC031 (UK) - final and public online
28. S04I_2006 (Australia) - final and public online
29. AA105W05 (USA) - final and public online

New data from VOS Lines:

1. VOS Palmer Lines 2011-2012 (USA) - final and public online
2. VOS Healy Lines 2011-2012 (USA) - final and public online
3. VOS Marcus Langseth Lines 2011-2012 (USA) - final and public online
4. VOS Hue_Long Lines 2008 (China) - final and public online
5. VOS Pacific Celebes Lines 2007-2012 (UK) - final and public online
6. VOS Pride of Bilbao Lines 2005-2010 (UK) - final and public online
7. VOS Ronald Brown Lines 2008-2012 (USA) - final and public online
8. VOS L.M.Gould Lines 2011-2012 (USA) - final and public online
9. VOS Explorer Lines 2008-2012 (USA) - final and public online
10. VOS Skogafoss Lines 2003-2007 (USA) - final and public online
11. VOS Polar Star Lines 2001-2002 (USA) - final and public online

New Moorings and Time Series data:

1. CARIACO 1996-2011 (USA/Venezuela) - final and public online
2. KEO_145E_32N 2009-2010 (USA) - final and public online

3. KERFIX TS 1990-1995 (France) - final and public online
4. OWS-Mike 2001-2007 (Norway) - final and public online
5. Grey's Reef 2007-2011 (USA) - final and public online

New Coastal data:

1. Coastal_UG_Gulf_of_Mexico_2007 (USA) - surface final and public data online
2. Belgica 2006-2008 (Belgium) - bottle final and public data online
3. CANOBA-Pelagia 2001-2002 (Belgium) - bottle final and public data online
4. Bigelow East Coast cruise 2011-2012 (USA) - surface final and public data online
5. Irish Sea Cruises 2007-2008 (UK) - surface final and public data online
6. Baltic Sea 1995-2011 (Germany) - surface final and public data online
7. R/V *Meteor* Mediterranean Sea 2011(Germany) – bottle final and public data online
8. Gordon Gunter GoM cruises 2008-2009 (USA) - surface final and public data online.

Benjamin Pfeil updated the group on technical aspects related to SOCAT. Most technical issues related to SOCATv1.5 were solved during the past year and secondary quality control for SOCATv2 was finalized. The individual cruise data files (2660 cruises) for SOCATv2 are currently being archived, metadata documented and DOIs assigned at PANGAEA. Each individual cruise file will directly link to the original metadata as provided by the PI and it will link to the DOI of the original dataset (as it went into SOCAT). By doing this, the issue of transparency will be taken to a new level allowing the user to directly follow up all steps involved in SOCAT. Data that are not yet archived at CDIAC will be made available to CDIAC in consultation with the PI. Data from SOCATv2 will be available through GEO's/GEOSS's *GEO Portal*, the ICSU World Data System and other relevant portals and we plan on making SOCAT available to the Global Carbon Project's World Carbon Atlas.

Pfeil also pointed out that in order to secure sufficient funding for data management activities, the community has to strengthen its efforts in promoting its data products (e.g. SOCAT and GLODAPv2) to other projects (e.g. MyOcean2) and data communities (e.g. ESA). He also highlighted the fact that in the near future (next couple of years) the community will have to be able to provide near real-time data (NRT) to keep up with other climate-related observing communities. This, for example, will be essential for ICOS-OTC (Integrated Carbon Observation System's Ocean Thematic Center) that is currently under negotiation. Pfeil went on to suggest that, to aid our efforts in improving the data standards and promoting available data products, IOCCP should consider joining GEO as an official partner or as a participating organization. The group agreed with this suggestion.

ACTION ITEM 25

Attend the International Conference on Marine Data and Information Systems (IMDIS13) and the GEO task meeting (GEOCL-02) to present IOCCP's work in the field of data management. (*Responsible: Pfeil. Timeframe: Boreal Fall 2013. Financial Implications: None*)

ACTION ITEM 26

Look into the possibility and available options for IOCCP joining GEO (*Responsible: Pfeil. Timeframe: Mid - 2013. Financial Implications: None*)

11. Updates from Partner Projects and Organizations

i. Global Carbon Project

Corinne Le Quéré updated the panel on GCP's recent activities. She started by summarizing the annual update of the Global Carbon Budget and Trends (for 2011), published on 3 December 2012. She also highlighted a couple of original peer-reviewed papers and a dataset that the 35 contributors from 10 countries produced along with the budget itself. Please visit the relevant page on the GCP's website for detailed information on budget's highlights, data source information, citing information, presentation-ready PowerPoint slides, downloadable figures, and even videos ready to be embedded in talks.

Le Quéré moved on to introduce a new initiative, called the Global Carbon Atlas (GCA), which the GCP is developing to assist the international science community to establish a common, and mutually agreed knowledge base supporting policy debate and action to slow the rate of increase of greenhouse gases in the atmosphere. The GCA will be an online-based tool for scientists, policy-makers and the general public, allowing users to extract (on various complexity levels) the information about global carbon pools, carbon fluxes, global and regional carbon dioxide budgets, as well as global and regional methane budgets. This ambitious undertaking requires an enormous scientific input and support as well as significant financial support. The latter was secured by the GCP by partnering with a global banking corporation. The former is an on-going process and Le Quéré asked the panel to help fill the ocean-related gaps in the Atlas. For example, the SOCAT dataset would be an extremely valuable addition to the Atlas. The panel agreed that SOCAT should be utilized as widely as possible. Are Olsen pointed out that the intellectual property rights of data providers should be discussed, and the citation strategy for the data used in the Atlas needs to be clarified. Finally, SSG members agreed that IOCCP and GCP should interact more closely in order to improve the availability of ocean carbon data in GCP's activities.

The discussion then moved to the RECCAP process and it was generally agreed that the publication process for future RECCAP iterations should be handled with a bit more oversight.

ACTION ITEM 27

Develop a mutually beneficial and acceptable way for the SOCAT dataset to be available for the Global Carbon Atlas purposes. Negotiate similar formal agreements for other ocean carbon datasets. (*Responsible: Pfeil, Olsen. Timeframe: Boreal Fall 2013. Financial Implications: None*)

ACTION ITEM 28

Communicate GCP's data needs and inform the community about developments related to the Global Carbon Atlas. (*Responsible: Telszewski. Timeframe: As requested by the GCP. Financial Implications: None*)

ii. EU GEOCARBON

Antonio Bombelli provided background information on the formation current activities and future plans of the EU FP7 Project GEOCARBON. He started by briefly introducing the Group on Earth Observations (GEO), a voluntary partnership of national governments and European Commission (90 members in total) and International Organizations (67 members) with a mandate in Earth observation or related issues. GEO was conceived in 2003, and established in 2005, in response to calls for action by the 2002 World Summit on Sustainable Development and by the G8. GEO's mission is to provide a framework within which interested stakeholders work together in a coordinated way toward a common objective: to develop a coordinated, comprehensive and sustained Global Earth Observation System of Systems (GEOSS) that would provide data and information to enhance decision making. Bombelli highlighted two GEOSS targets that led to conception of GEOCARBON Project. GEOSS aims to do the following:

- Achieve effective and sustained operation of the global climate observing system and reliable delivery of climate information of a quality needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle
- Develop and facilitate a comprehensive (atmosphere, ocean, land) global carbon observation and analysis system in support of monitoring-based decision-making and related environmental treaty obligations.

In early 2011, the European Commission responded by funding the GEOCARBON Project (01October 2011 - 30 September 2014) to develop a coordinated Global Carbon Observation and Analysis System, supporting the Group on Earth Observations (GEO) toward building a Global Earth Observation System of Systems (GEOSS) for carbon. 25 institutions partnered to:

- Assure the continuity and sustainability of the many existing monitoring networks at global level.
- Develop procedures allowing interoperability of the systems using different methods to monitor and analyse various aspects of the carbon cycle.
- Develop tools to reduce high uncertainty in estimates of carbon sources and sinks regions at global and regional level.
- Attempt to translate the impressive scientific knowledge at hand into policy relevant information

Bombelli highlighted several areas of GEOCARBON activities that overlap with long-term involvement of IOCCP. The panel suggested that both communities (often overlapping) should seek opportunities for communication to improve the efficiency of their initiatives. Bombelli suggested that an IOCCP representative could give a keynote talk during the GEO Conference "Towards a global Carbon Observing and Analysis System: Progresses and Challenges" to be held in Geneva, 1-2 October 2013. He also suggested that IOCCP should be actively involved in the GEO CL-02

"Global Carbon Observation and Analysis" Task meeting to be held in Geneva, 3-4 October 2013. The panel agreed on both counts.

ACTION ITEM 29

Attend and give the IOCCP overview presentation at the GEO Conference "Towards a Global Carbon Observing and Analysis System: Progresses and Challenges" to be held in Geneva, 1-2 October 2013. Attend the GEO CL-02 "Global Carbon Observation and Analysis" Task meeting to be held in Geneva, 3-4 October 2013. (*Responsible: Tanhua, Telszewski. Timeframe: October 2013. Financial Implications: Low*)

iii. U.S. Ocean Carbon and Biogeochemistry

Heather Benway updated the panel on recent OCB activities and provided an insight into their planned activities with an emphasis on potential collaborations. Benway started by reminding the panel that OCB was established to promote the knowledge of the evolving role of the ocean in the global carbon cycle, in the face of environmental change, through studies of marine biogeochemical cycles and associated ecosystems. She then moved on to reporting on major recent OCB activities that included the following:

- Global Inter-comparability in a Changing Ocean: An International Time-Series Methods Workshop (*28-30 November 2012, BIOS, Bermuda, organized jointly with IOCCP and IOC-UNESCO*)
- CLIVAR/OCB joint working group meeting: Oceanic carbon uptake in the Coupled Model Inter-comparison Project phase 5 (CMIP5) models (*Dec. 2012, San Francisco, CA, organized jointly with U.S. CLIVAR*)
- CLIVAR/OCB joint working group meeting: Heat and carbon uptake by Southern Ocean (*Dec. 2012, San Francisco, CA, organized jointly with U.S. CLIVAR*)
- GEOMICS workshop (*11-13 February 2013, Friday Harbor, WA*)
- Gulf of Mexico coastal synthesis workshop (*March 2013, St. Petersburg, FL, organized jointly with NACP*)

Benway informed the panel about two upcoming activities:

- 2013 OCB summer workshop (*July 22-25, 2013, Woods Hole, MA*)
- U.S. Ocean Acidification PI meeting (*Sept. 18-20, 2013, Washington, DC*)

Finally, she listed activities that could be organized together with IOCCP:

- Follow-on activities from time-series methods workshop in Bermuda (OCB/IOCCP/IOC-UNESCO collaborations?)
- Joint efforts to coordinate across ocean time-series and field programs to facilitate data acquisition for satellite-borne ocean color data calibration-validation activities (OCB/IOCCG/IOCCP collaborations?)
- Short course on working with large hydrographic data sets/products (2015, dates/venue TBD, OCB/IMBER/IOCCP collaborations?)

The panel agreed that working with the US OCB toward goals set by participants of the Bermuda workshop is very important and well within the IOCCP's core mission. Are Olsen suggested that IOCCP would also be very interested in building the capacity to handle large data sets/products related to marine biogeochemistry. The panel agreed that IOCCP should work with the US OCB and others towards organizing a short course for early-career scientists.

ACTION ITEM 30

Organize, in collaboration with the US OCB and other interested partners, a short course on working with large hydrographic data sets/products. (*Responsible: Olsen, Pfeil, Telszewski. Timeframe: 2015. Financial Implications: Low to Medium*)

iv. EU CARBOCHANGE

Toste Tanhua updated the panel on the previous year's activities of the EU FP7 CARBOCHANGE Project – "Changes in carbon uptake and emissions by oceans in a changing climate". The IOCCP SSG is relatively familiar with CARBOCHANGE activities since Telszewski serves on the International Advisory Board of CARBOCHANGE and Tanhua, Olsen, Pfeil and Schuster are leaders in the organizing structure of the project.

12. IOCCP's role in the Integrated Framework for Sustained Ocean Observing (FOO)

A key recommendation from the OceanObs'09 Conference held in Venice in September 2009 (www.oceanobs09.net) was for international integration and coordination of interdisciplinary ocean observations. The Conference was sponsored by many international and national ocean agencies, and attended by representatives of ocean observation programs worldwide. Based on impressive agreement among the many groups at the Conference and their strong desire to work collectively, the sponsors commissioned a Task Team to develop an Integrated Framework for Sustained Ocean Observing (hereafter referred to as the FOO).

The FOO structure is such that the three Ocean Observing System Panels (Physics, Biology/Ecology and Carbon/Biogeochemistry) interact through virtual and in-person meetings to come up with a set of Essential Ocean Variables (EOVs) which would then be promoted as fundamental measurements needed to address the current scientific and societal ocean/climate-related issues and enable funding of the interdisciplinary, integrated global ocean observing network (the improved, multidisciplinary GOOS). Each panel has a leader organization, which is tentatively tasked to consult the community and create a loose consortium of relevant and interested organizations, helping to justify and negotiate the inclusion of certain parameters in the final list of EOVs.

The IOCCP was asked by the Task Team to lead the Biogeochemistry Panel very

early on in the Framework drafting process. The IOCCP SSG replied positively to this request and agreed to take on some coordination tasks for a wider range of biogeochemical parameters beyond inorganic carbon (coordination of designing and implementation of a large scale observing network), in particular oxygen and nutrients, in order to play its role in the FOO. As a first step in this process we have decided to extend the SSG with two new members, each with an expertise in nutrient and oxygen observations, respectively. Michio Aoyama agreed to lead IOCCP's efforts in nutrients coordination and joined the IOCCP SSG on 1 January 2013. We are still searching for an adequate researcher to lead IOCCP's oxygen efforts.

Further to expanding the SSG, the IOCCP has been discussing (internally and externally) the details of its role in the FOO for the past two years. During the 8th Session, the first executive decisions on Framework implementation were finally taken. First, the panel approved the Terms of Reference (ToR) for the FOO's Biogeochemistry Panel drafted during the Second Meeting of the GOOS Steering Committee (Tanhua and Telszewski attended) that took place 25-27 March 2013 in Qingdao, China. IOCCP SSG members also agreed to join the FOO's Panel.

In the short term, the IOCCP SSG agreed to follow a 4-step work plan leading to the initial assessment of the existing observing network. The IOCCP will compile the available information on societal and scientific requirements regarding the marine biogeochemistry parameters necessary for inclusion into the FOO as EOVs. The IOCCP will then consult with programmatic and institutional partners on their requirements for the multidimensional feasibility assessment of the proposed parameters. It is important that observing, modeling and sensor/instrument developing communities are involved. The IOCCP will then lead the multidimensional feasibility assessment of the proposed parameters built on the FOO recommendations and summarize the results for inclusion into the Global Climate Observing System. Finally, the IOCCP will produce a summary publication of the multidimensional feasibility assessment of the marine biogeochemistry parameters necessary for inclusion into the FOO as EOVs.

ACTION ITEM 31

Remain in frequent communication with the FOO Ocean Observing System Panels for Physics and Ecosystem/Biology including attending to their annual SSG meetings. *(Responsible: Tanhua, Telszewski. Timeframe: On-going. Financial Implications: Low)*

ACTION ITEM 32

Remain in frequent communication with the GOOS SC and GOOS Secretariat for coordination of FOO-related activities. *(Responsible: Tanhua, Telszewski. Timeframe: On-going. Financial Implications: None)*

ACTION ITEM 33

Organize an expert workshop (by invitation only) of approximately 15 participants to define scientific and societal requirements that need to be addressed by proposed EOVs and to initiate the multidimensional parameter's feasibility-assessment based on the FOO recommendations. *(Responsible: Tanhua, Lorenzoni, Telszewski. Timeframe: December 2013. Financial Implications: Medium to High)*

ACTION ITEM 34

Organize a town-hall meeting during the Ocean Sciences Meeting 2014 to inform a wider oceanographic community about the outcomes of the initial multidimensional feasibility assessment of the marine biogeochemistry parameters necessary for inclusion into the FOO as EOVs. (*Responsible: Telszewski, Tanhua, SSG members. Timeframe: February 2014. Financial Implications: Medium*)

ACTION ITEM 35

Create a page on the IOCCP website for FOO-related activities. (*Responsible: Telszewski. Timeframe: Mid-2013. Financial Implications: None*)

13. Vision 2019

This brainstorming session lead by Tanhua aimed at drafting a list of actions and activities that the community needs to take in order to progress with an overall goal of better understanding the recent and future changes in marine biogeochemistry. Four years after OceanObs'09 and six years before OceanObs'19, the IOCCP composed this Vision 2019 and plans to work on it throughout the next 12 months so that it becomes a more firm, long-term action plan halfway through the inter-sessional period of the OceanObs series.

The session resulted in a “laundry” list of general and specific recommendations for action divided in three categories: (i) deliverables needed for more complete understanding of marine biogeochemistry, (ii) data-related issues and (iii) specific activities in 2013-2014 and beyond that could address (i) and (ii).

(i) IOCCP Vision 2019 deliverables

- Decadal rate of change in ocean acidification (regional and global)
- Trends in nutrient supply to the surface waters
- Ocean interior oxygen distribution
- Rates of deoxygenation
- Regional and global rates of carbon storage and uptake
- Rate of shallowing of carbonate (e.g. aragonite) saturation state depth
- Regional and global fluxes of carbon and their changes
- N₂O fluxes/concentration changes
- N-fixation (processes)
- Denitrification (processes)
- N/P ration changes in deep water
- Particle flux/remineralization depths
- Improvement in the spatial resolution of observations
- Improvement in the temporal resolution of observations
- Improvement in the accuracy of measurements
- Better understanding of uncertainties
- Community debate on the use of proxy parameters

(ii) IOCCP Vision 2019 data needs

- Further streamlining data flows (formats, protocols)
- Relational database
- Early submission of encrypted data for quality control by community-agreed tools rather than submission several years after data collection
- Development of a worldwide requirement for addition of uncertainty estimate in data and data products
- Development of quality-control procedures for sensor data
- Development of calibration procedures for autonomous sensors
- Creation of an international ocean interior data quality assessment group
- Regular updates to data synthesis products

(iii) IOCCP Vision 2019 implementation plans

- 2nd GOA-ON workshop in St. Andrews, Scotland as per Action Item 16
- Fall 2013 EOJ/vision'19 workshop as per Action Item 33
- Sensors workshop in 2014 as per Action Item 22
- Town-hall on repeat hydrography data and observations at the Ocean Sciences Meeting (OSM) 2014 as per Action Item 10
- Town-hall on EOJs at the OSM 2014 as per Action Item 34
- Time Series session at the OSM 2014 as per Action Item 15
- SOCATv3 public release event in 2014
- 3rd GOA-ON workshop to be organized in 2014/2015
- Follow-up on the Time Series workshop held in late 2012, with specific focus on instruments and sensors as per Action Item 22

14. Project Office and general administration

i. New Project Director

After three and a half years of service, on 31 September 2012, Dr. Kathy Tedesco stepped down as the Director of the IOCCP. At the same time Dr. Maciej Telszewski has been appointed the new Project Director effective 1 October 2012. Telszewski has served as the IOCCP Deputy Director since January 2011, during which time he has been increasingly involved in coordinating the numerous IOCCP activities. Due to financial constraints, IOCCP has not been able to employ a second member of staff.

ii. Rotations of SSG members

In line with the SSG Terms of reference, three members (Jean-Pierre Gattuso, Pedro Monteiro and Yukihiro Nojiri) rotated off after 6 years of dedicated service to the IOCCP.

Three members (Masao Ishii, Bernadette Sloyan and Are Olsen) will complete their 3-year terms at the end of 2013 and were all asked to stay on the panel for an additional term. They all agreed.

Ute Schuster was asked to complete her second term (finishing at the end of 2014) leading the Underway CO₂ measurements theme, vacated by Pedro Monteiro. She agreed.

Data Assimilation and Flux Maps theme (led by Ute Schuster) was unanimously removed from the list of IOCCP activities.

Michio Aoyama and Richard Feely joined the panel and will be responsible for Nutrients and Ocean Acidification respectively.

ACTION ITEM 36

Search for an adequate SSG member responsible for oxygen observations. (*Responsible: Tanhua, Telszewski. Timeframe: Mid-2013. Financial Implications: None*)

iii. New IOCCP Website

The IOCCP launched its new, completely re-designed website. In addition to updating the design, a complete technical change to incorporate the Content Management System (CMS) was implemented. This allows user-friendly administration of content by non-experts, including layout, volume and order of elements of the website. The CMS also allows for administrative access to analytical statistics allowing for assessment of usefulness of each element of the website. Aesthetic re-design of the IOCCP website brought it up to date with other research project's websites. IOCCP's outreach activities are not plentiful and the website should play an outreach role in the most effective way possible. Additional functionalities like a Jobs section, an interactive Calendar and a slider highlighting the most important events and actions should help IOCCP's website become an information hub for international activities in marine biogeochemistry.

ACTION ITEM 37

Enable website statistics software for each page of IOCCP website. (*Responsible: Telszewski. Timeframe: June 2013. Financial Implications: None*)

iv. SSG ToR update

The IOCCP SSG Terms of Reference were drafted and approved in its draft form during the Seventh SSG Session. Following a series of edits, the finalized version was distributed prior to the Eighth SSG Session and was approved during the meeting.

ACTION ITEM 38

Upload the ToR for IOCCP SSG members to IOCCP website. (*Responsible: Telszewski. Timeframe: June 2013. Financial Implications: None*)

v. IOCCP ToR update

In order to fulfil the mission of providing technical services to the community efficiently, the IOCCP needs to acknowledge the multi-stressor approach employed more and more often by marine biogeochemists, especially those concerned with climate-related issues. For scientific and financial reasons observations become multidisciplinary, as do platforms. The current IOCCP Terms of Reference (ToR) need to be updated to reflect the expansion of IOCCP efforts beyond carbon to include carbon-related parameters like nutrients and oxygen. This is also necessary to align the IOCCP ToRs with its leading role in the Framework for Ocean Observing.

Tanhua and Telszewski will draft and update the current ToRs. The SSG will be given adequate time to familiarize themselves with the updated document and the panel will discuss it during one of the Virtual Meetings. The SSG will then submit the proposed changes for approval by IOCCP sponsors.

ACTION ITEM 39

Draft an update to the IOCCP ToRs. (*Responsible: Tanhua, Telszewski. Timeframe: End 2013. Financial Implications: None*)

ACTION ITEM 40

Submit the updated ToRs to IOCCP sponsors for approval. (*Responsible: SSG. Timeframe: End 2013. Financial Implications: None*)

vi. IOCCP annual cycle

The SSG approved the IOCCP annual cycle proposed by Telszewski. The cycle consists of 3 quarterly Virtual Meetings and one in-person annual SSG meeting. The SSG will produce material for 4 quarterly *IOCCP Conveyors* to be published in the middle of each inter-sessional period (around 6 weeks after each meeting).

Dates of an in-person meeting will continue to depend on SSG's participation in other thematic meetings to reduce travel time and costs, however it is recommended that the SSG meets at the end or at the beginning of a calendar year rather than in the middle of a calendar year.

Annual cycle for 2013:

Meetings:	IOCCP Conveyor
April – In person meeting	Q1 – January
July – Q3 2013 VM	Q2 - June
October – Q4 2013 VM	Q3 - September
	Q4 - December

ACTION ITEM 41

Organize the 9th IOCCP SSG meeting. (*Responsible: Telszewski, Tanhua. Timeframe: First half of 2014. Financial Implications: Medium to High*)

vii. Budget and fundraising activities

The IOCCP Project Office support is provided by the US National Science Foundation (NSF) through a grant to SCOR. A new continuing 3-year grant was approved beginning 1 October 2012. Generous in-kind support for the Project Office is provided by the Institute of Oceanology of Polish Academy of Sciences (IO PAN).

In 2013 program support for the IOCCP comes from three sources:

- NSF through a grant to SCOR
- IOC-UNESCO utilizing the Republic of Korea grant *Ocean carbon sources and sinks*. This line is earmarked for SOCAT and Time Series activities.
- Global Ocean Observing System through IOC-UNESCO. GOOS money is earmarked for activities related with IOCCP's role in the FOO.

The IOCCP begins this inter-sessional period (May 2013 – early 2014) with a budget of about \$70,000 for activities. Given this level of available funding, action items are assigned a financial implication level based on “low” (<\$5,000), “medium” (<\$15,000), and “high” (>\$15,000).

The IOCCP awaits approval of the proposal submitted to the Polish Ministry of Science and Higher Education, which, if successful, will allow for employment of an additional staff member in the Project Office.

Are Olsen reported that IOCCP's involvement in a Sensor's proposal bidding for the EU funds was rejected. The bidding consortium decided that it would not propose any involvement in the international inter-comparison experiment for developed sensors, which was originally considered as a role for IOCCP in the consortium.

Fundraising activities were discussed several times during the meeting. SSG members agreed that a general draft IOCCP proposal should be prepared and available for editing to the SSG. The SSG is urged to actively look for potentially suitable calls for proposals and when a relevant one comes up an (a series of) ad-hoc virtual meeting(s) should be organized to compose a specific text bringing IOCCP's expertise to a specific call.

ACTION ITEM 42

Draft a generic IOCCP proposal. (*Responsible: Telszewski, Tanhua. Timeframe: End of 2014. Financial Implications: None*)

Meeting Agenda

Monday, 22 April 2013

- 13:00 **Opening of the meeting**
- Meeting opening by the Chair
 - Housekeeping
- 13:30 **Update and review on the developments during the last year**
- Funding proposals
 - NSF funding through SCOR, IOC funding, GOOS funding
 - Website
 - Internal administration
 - IOCCP Annual Cycle
- 14:00 **GOOS-FOO**
- Overall update
 - GOOS SC Meeting in China
 - IOCCP in the FOO
- 15:00 **Coffee break**
- 15:30 **Thematic updates since last SSG meeting**
- ~15:30 Time Series Efforts*
 - ~15:50 Underway CO₂ Observations*
 - ~16:10 Synthesis Activities: Surface Ocean*
 - ~16:30 Ocean Acidification*
 - ~16:50 Nutrients*
 - ~17:10 Ocean Interior Observations*
 - ~17:30 Instruments and Sensors*
- 17:50 **Final Remarks**
- 19:00 **Group Dinner**

Tuesday, 23 April 2013

- 09:00 **Review of Action Items from the last SSG meeting**
- 10:00 **Thematic updates since last SSG meeting**
- ~10:00 Synthesis Activities: Ocean Interior*
 - ~10:20 Data and Information Management*
- 10:40 **Coffee Break**
- 11:00 **Updates from partner projects and organizations**
- ~11:00 Global Carbon Project*
 - ~11:20 GEOCARBON*
 - ~11:40 US Ocean Carbon and Biogeochemistry*
 - ~12:00 CARBOCHANGE*
 - ~12:20 Discussion*
- 12:30 **Lunch**

- 13:30 **IOCCP activities 2013-2014**
- Fall 2013 FOO BGC-EOV workshop
 - Spring 2014 Town Hall
 - SSG Meeting
 - Other
- 14:30 **Vision 2019 (OceanObs'19)**
- 15:30 **Coffee break**
- 16:00 **Budget update**
- 2012/13 IOCCP funded activities
 - Current budget
 - Fundraising
- 16:30 **Rotations of SSG members and IOCCP themes, IOCCP ToR**
- 17:00 **Time margin in case we are a bit late**
- 17:45 **Closing remarks, summary of action items**