

# Intergovernmental Oceanographic Commission



## IOC-SCOR International Ocean Carbon Coordination Project

Sixth Session of the Scientific Steering Group  
Paris, France  
17-18 September, 2011

IOCCP Report Number 24

**UNESCO**



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.

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## I. AGENDA

<b>IOCCP SSG MEETING</b>	
<b>17-18 September 2011</b>	
<b>UNESCO Annex</b>	
<b>Paris, France</b>	
17 September 2011	
<b>09:00</b>	<b>Welcome and Logistics</b>
<b>09:30</b>	<b>Meeting Updates</b>
	Surface Ocean CO <sub>2</sub> Data-to-Flux Workshop-Monteiro
	Surface-Interior Meeting-Gruber
<b>10:15</b>	<b>Related Activities</b>
	U.S. Carbon Cycle Science Plan-Sabine
	SOLAS/IMBER-Bakker, Gruber, Tedesco
<b>12:30</b>	<b>Project Updates and Future Priorities</b>
	Surface Ocean CO <sub>2</sub> Data- Bakker
	Underway pCO <sub>2</sub> Measurements-Monteiro
	Repeat Hydrography-Sloyan
	A Framework for Ocean Observing-Fischer
	Ocean Interior Data-Ishii
	Surface Flux Maps/Data Assimilation-Schuster
	Time Series Stations-Sabine
	Data and Information Management-Kozyr
	IPCC-Nojiri
	Ocean Acidification-Tedesco
18 September 2011	
<b>9:00</b>	<b>Related Activities (cont.)</b>
	RECCAP-Schuster
	CARBOCHANGE-Tanhua
<b>11:00</b>	<b>Comparison exercises</b>
	Alliance for Coastal Technology-Sabine
<b>14 :00</b>	<b>Discussion and Action items</b>
	Action Items - Tedesco
	Project Office Update – Tedesco
<b>15:00</b>	<b>Close</b>



## II. PARTICIPANT LIST

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## **III. REPORT**

### **1. Introduction**

The Sixth IOCCP Scientific Steering Group meeting was held 17-18 September 2011 at UNESCO Headquarters in Paris, France. Chris Sabine (Chair-NOAA/PMEL, USA) was joined by members Alex Kozyr (CDIAC, USA), Masao Ishii (XXX), Pedro Monteiro (CSIR, South Africa), Yukihiro Nojiri (NIES, Japan), Ute Schuster (UEA, UK), Bernadette Sloyan (CSIRO, Australia), and Toste Tanhua (IfM-Geomar, Germany). Dorothee Bakker (UEA, UK) and Nicolas Gruber (ETH, Switzerland) attended as representatives of the SOLAS-IMBER Carbon Working Groups. In addition, Albert Fischer (IOC/UNESCO) and David Hydes (NOCS, UK) were invited to present updates on “A Framework for Ocean Observing” and Integrated Carbon Observing System (ICOS), respectively. Ed Urban (SCOR), Melchor Gonzalez (U Las Palmas, Spain), Are Olsen (IMR, Norway) and Jean-Pierre Gattuso (CNRS-UPMC, France) were unable to attend.

Chris Sabine and Kathy Tedesco welcomed the IOCCP SSG to the 2011 steering group meeting. Sabine provided a brief history of the IOCCP and reminded the group of the terms of reference and basics of how the IOCCP is supposed to interact with SOLAS, IMBER, and other international research programs. He also introduced Maciej Telszewski as a new project coordinator since the last SSG meeting. Maciej Telszewski has been working with Kathy Tedesco in Paris to run the IOCCP for the last several months. Chris Sabine also introduced Toste Tanhua as the new sole chair of the IOCCP. He was made co-chair with Chris Sabine at the 2010 SSG meeting, but as of this meeting Sabine will rotate off the IOCCP SSG and Tanhua will remain as the IOCCP chair. At this point Tanhua took control of the meeting. Toste Tanhua thanked Chris Sabine for his years of service and dedication to the IOCCP. The group presented Chris with a gift to express their appreciation.

### **2. Meeting Updates**

#### ***2.1. The IOCCP Surface Ocean CO<sub>2</sub> Data-to-Flux Workshop***

The IOCCP Surface Ocean CO<sub>2</sub> Data-To-Flux Workshop was held in Paris, France on 12-13 September, 2011. It brought together over 40 participants from 10 different countries to assess the progress made since 2009 and to discuss next steps towards achieving decadal goals set out to the surface ocean CO<sub>2</sub> flux community during OceanObs'09. The workshop used the Community White Papers (CWPs) from the Surface Ocean Observation community together with other topic specific CWPs as a starting point to assemble issues and participants from all the relevant communities (observational, modeling, sensor development, platform development & operations, data management) that have a strong contribution to make in enabling the decadal goals to be achieved in a realistic way.

Perhaps one of the biggest challenges for the surface ocean CO<sub>2</sub> flux community is the reduction of the global flux uncertainty to a level that is necessary and meaningful to resolve interannual trends. Presently, this is considered to be in the 10 – 15% range. While this has been achieved through observations by the Ship of Opportunity Programme (SOOP) in some regions, such as the North Atlantic, this approach alone is not feasible in the Southern Ocean south of 30°S where seasonal biases are an additional challenge.

Accordingly, discussions in four plenary sessions and theme focused break-out groups focused around four main topics:

- Identification of key spatial sampling domains with focus on resolving the seasonal cycle within these domains. Advances in regions with the least data coverage (Southern Ocean and South Pacific) and regions of highest importance for understanding of the global air-sea flux were specifically discussed.
- Surface Ocean CO<sub>2</sub> Atlas (SOCAT) has emerged in the past 4 years as a platform to support the global CO<sub>2</sub> observing community to agree to minimum data quality standards that would help reduce the sampling error contribution to regional and global flux uncertainties. As the global surface ocean CO<sub>2</sub> data set has become both better distributed, improved quality and sustained it has also become useful resource for: data assimilation approaches, empirical models' applications and input into operational carbon - climate models. Current status and future plans for utilizing SOCAT using these methods were discussed.
- Requirements for widening of observational network beyond pCO<sub>2</sub> to include: DIC, TA, NO<sub>3</sub>, O<sub>2</sub>, O<sub>2</sub>-Ar, Bio-optics. Emerging advances of sensor technology are likely to make these observations viable on autonomous platforms with improved precision, accuracy and reduced power consumption.
- Linking surface ocean CO<sub>2</sub> and ocean acidification research, especially in the coastal domain.

The organizing committee consisted of Dorothee Bakker, Truls Johannessen, Pedro Monteiro, Chris Sabine, Ute Schuster, Kathy Tedesco, and Rik Wanninkhof.

### **ACTION ITEM 1**

Prepare a workshop report. (*Responsible: Telszewski and Tedesco. Timeframe: Spring 2012. Financial Implications: None*)

### ***2.2 The Ocean Carbon Cycle at a Time of Change: Synthesis and Vulnerabilities***

The Ocean Carbon Cycle at a Time of Change: Synthesis and Vulnerabilities Workshop was held in Paris, France on 14-16 September, 2011. The workshop, hosted and co-sponsored by IOCCP along with SOLAS and IMBER, brought together over 120 participants from 17 countries interested in developing an integrated view of how the ocean carbon cycle has changed in the recent decades. Of interest were data synthesis activities, analyses and modeling studies focusing on air-sea CO<sub>2</sub> fluxes, changes in ocean surface and interior carbon properties, and how the changes in these realms are connected to each other.

The uptake of anthropogenic CO<sub>2</sub> from the atmosphere, climate fluctuations, as well as long-term trends in ocean circulation and biology have led already to substantial changes in the ocean carbon cycle, with potentially larger changes looming ahead. In the last decade, substantial efforts have been undertaken to measure these changes, and a number of projects are underway to synthesize them and to put them into the context of climate variability and change. In particular, the SOLAS-IMBER carbon working groups jointly with IOCCP and other international organizations (e.g. PICES, EU FP7) have initiated and supported a number of analysis and synthesis activities such as SOCAT, CARINA and PACIFICA, with the goal to arrive at (i) homogeneous and quality controlled data sets and (ii) regional to global assessments of the changing ocean carbon cycle.

The meeting consisted of plenary talks on carbon changes in the surface and interior ocean,

drivers and detection of changes, basin syntheses, and the official release of SOCAT v 1.5. There were also poster sessions (40 posters) and meetings of individual working groups. The meeting results will be published as an EOS article and will form the basis of a number of planned synthesis papers to be published in a special volume. The results will provide critical input to the further development of the ocean carbon observing systems, and to the 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).

The organizing committee was led by Nicolas Gruber (ETH-Zurich, Switzerland) and included Nicolas Metzl (IPSL/UPMC, France), Rik Wanninkhof (NOAA/AOML, USA), Dorothee Bakker (UEA, UK), Masao Ishii (JMA-MRI, Japan), Andrew Lenton (CSIRO, Australia), Emilie Brévière (SOLAS), Lisa Maddison (IMBER), Kathy Tedesco (IOCCP), and Maciej Telszewski (IOCCP).

### **3. Related Activities**

#### ***3.1. New U.S. Carbon Cycle Science Plan***

Chris Sabine briefed the SSG on the new U.S. Carbon Cycle Science Plan that was finalized in August 2011 and will be published shortly. The plan has three overarching science questions: 1) How do natural processes and human actions affect the carbon cycle, on land, in the atmosphere, and in the oceans? 2) How do policy and management decisions affect the levels of atmospheric carbon dioxide and methane? 3) How are ecosystems, species, and resources impacted by increasing greenhouse gas concentrations, the associated changes in climate, and carbon management decisions? There is a strong ocean component in the science plan. It calls for sustained large scale observations and for process studies. It promotes ocean studies for improved understanding of the global carbon cycle and for quantifying ocean acidification. The expectation is that this document will guide global carbon cycle research conducted by U.S. scientists for the next decade. Although it does not mention the IOCCP directly, it does make strong statements about the need for international coordination and cooperation for carbon cycle research and the importance of U.S. scientists participating in these international coordination efforts.

#### ***3.2 SOLAS/IMBER Working Groups***

##### ***3.2.1 Joint SOLAS/IMBER Carbon Working Group on Surface Ocean Systems (SIC WG1)***

Dorothee Bakker took over from Nicolas Metzl as interim chair of SIC WG1 in March 2011. Andrew Lenton has joined SIC WG1 in July 2011 and will take over as chair with immediate effect.

Recent activities of the working group include its contributions to:

- SOCAT version 1.5
- Joint IMBER/SOLAS/IOCCP Ocean Surface and Interior Carbon synthesis meeting (14-16/09/2011) at UNESCO in Paris and a possible Special Issue
- SOCAT keynote at the SOLAS/EGU/ESA meeting in Frascati (29 November-2 December 2011);
- Carbon synthesis session at the 2012 Ocean Sciences meeting (20-24 February 2012, Salt Lake City, USA)
- SOLAS Open Science meeting (Seattle, 7-10 May 2012).

Several potential activities for SIC WG1 were raised during the joint IMBER/SOLAS/IOCCP Ocean Surface and Interior Carbon synthesis meeting, e.g. the organisation of a scientific workshop comparing mapping products based on SOCAT.

#### **ACTION ITEM 2**

Contact Andrew Lenton, new chair of SIC WG1, requesting a list of parameters they would like to include and requirements for widening of observational network beyond pCO<sub>2</sub> (e. g., DIC, TA, NO<sub>3</sub>, O<sub>2</sub>, O<sub>2</sub>-Ar). (*Responsible: Telszewski and Lenton. Timeframe: Spring 2012. Financial Implications: None*)

#### **ACTION ITEM 3**

Provide feedback to Andrew Lenton regarding potential role of the IOCCP following review of the list. (*Responsible: Telszewski, Tedesco and IOCC SSG. Timeframe: Summer 2012. Financial Implications: None*)

#### *3.2.2 Joint SOLAS/IMBER Carbon Working Group on Interior Ocean Carbon (SIC WG2)*

Niki Gruber provided background information on the formation of the SOLAS/IMBER Carbon Working Groups (SIC) and their activities. Working Group 2 coordinates international research on ocean interior biogeochemistry, undertakes synthesis activities and aims to develop sustainable observing systems, including the addition of oxygen sensors to the international ARGO float programme (ARGO-O<sub>2</sub>).

SIC Working Group 2 had their first steering committee meeting on 16 September and listed activities of interest to the working group including 1) continue support of large-scale synthesis efforts (develop a cookbook of data analysis, support analysis teams), 2) produce a statement paper on carbon observation data policies and benefits of open access data for a broad audience from policymakers to individual researchers, 3) support the development of Bio-Argo. Work with US GLOBE group and update the white paper, 4) start analysis of coastal-open ocean exchange, and 5) investigate the status of global synthesis of POC and DOC.

#### **ACTION ITEM 4**

Coordinate with SIC WG2 on the role of IOCCP in the conclusion of PACIFICA, estimates of anthropogenic carbon, and coastal margins. (*Responsible: Tedesco and Gruber. Timeframe: Ongoing. Financial Implications: Low*)

#### **ACTION ITEM 5**

Coordinate with SIC WG2 on global synthesis of POC and DOC. Provide data and information to the community. Possibly co-sponsor a POC and DOC intercomparison exercise. Discuss with Denis Hansell to see if this is necessary. (*Responsible: Tedesco and Gruber. Timeframe: Fall 2012. Financial Implications: Medium*)

#### *3.2.3 Joint SOLAS/IMBER Carbon Working Group on Ocean Acidification (SIC WG 3)*

The SOLAS/IMBER Carbon Working Group on Ocean Acidification (SIOA) was launched in September 2009 to coordinate international research efforts in ocean acidification and undertake synthesis activities in ocean acidification at the international level. Members include Jim Barry (USA), Jelle Bijma (Germany), Minhan Dai (China), Richard Feely (USA), Jean-Pierre Gattuso, *Chair* (France), Richard Matear (Australia), Yukihiro Nojiri (Japan),

James Orr (France), Ulf Riebesell (Germany), Lisa Robbins (USA) and Carol Turley (UK). Recent SIOA activities include the publication of Ocean Acidification (Gattuso J.-P. & Hansson L. (Eds.), 2011. Ocean Acidification, 326 p. Oxford: Oxford University Press) and contributions to the IPCC AR5 due to be published in March 2014.

Due to an increasing number of research projects and the fact that overarching, international activities are largely unsupported, a proposal was prepared and submitted by the SIOA Working Group and the IOA-Reference User Group to develop an International Coordination office (ICO). Many programmes and agencies have endorsed the office, including the IOC and SCOR, and the outcome is expected soon.

The group discussed the very close connection between IOCCP and the SOLAS/IMBER Carbon Working Groups and thought it would be beneficial to have an SSG representative serve on each of the SIC working Groups.

#### **ACTION ITEM 6**

Determine interfaces between the OA International Coordination Office and IOCCP.

*(Responsible: Tedesco and Gattuso. Timeframe: Ongoing. Financial Implications: None)*

#### **ACTION ITEM 7**

Work with SOLAS/IMBER Carbon Working Group chairs to select appropriate SSG representatives to serve on the SIC Working Groups. *(Responsible: Tanhua, Tedesco, Lenton, Gruber, Gattuso. Timeframe: Ongoing. Financial Implications: None.)*

### **3.3 ICOS**

David Hydes outlined the aims and strategies being developed in Europe within an Integrated Carbon Observing System (ICOS). ICOS will organize and support *in situ* observations of greenhouse-gas fluxes and dynamics required to provide the process understanding and quantification of carbon sources and sinks on a regional scale together with data synthesis activities to produce statistically robust estimates of CO<sub>2</sub> sources and sinks resolved at appropriate time and space scales. These coordinated, long-term, high-quality observations from across Europe will, along with climate modeling, enable improved prediction of future variability of carbon sources and sinks that will inform policy and underpin future mitigation strategies. Ultimately the observations ICOS coordinates and endorses will be linked to non European observations to form a global carbon observing system, and the numerical modeling it promotes will enable the management of greenhouse gas emissions to be undertaken in an informed, evidence based manner. A key concept of ICOS is the move from discrete science and process based studies to the development of a sustained observing system with a life-time of the several decades.

Hydes then presented the proposal for creating the Marine Carbon Network International Cooperation Office (MCNICO) as a coordination body for the marine component of ICOS. MCNICO is proposed to be hosted at the National Oceanography Centre Southampton and to be funded by the UK NERC. Hydes outlined the following key objectives of the MCNICO:

- To lead the development of the Ocean Thematic Centre (OTC) of ICOS to link existing carbon observing programmes and to produce regular estimates of European carbon budgets
- To coordinate the ongoing and planned wider national activities in Europe and North America that will support putting into place the vision of a North Atlantic network and to link the activities of ICOS to international efforts aimed at delivering similar

- To develop recommendations for integration and enhancement of the observing system; data management and mechanisms for wide use of the data for scientific and assessment purposes. This is so that policy decisions and mitigation strategies regarding the management of greenhouse gas emissions can be made in an informed and evidence based manner.
- To communicate the current state of knowledge, scientific outputs and added value products regarding the magnitude and stability of the ocean carbon sink to a range of stakeholders and key decision makers including the Global Carbon Project, national governments and the general public.

The MCNICO will work closely with IOCCP. This collaboration will link the work of the ICOS OTC to the global ocean carbon coordination efforts of IOCCP by providing an efficient information exchange and global sharing of effort on methods development, network and data-base integration. Finally, Hydes asked the IOCCP SSG to support the creation of the Marine ICOS to enhance the European structure of the global ocean observing system.

#### **ACTION ITEM 8**

Provide feedback to David Hydes regarding ICOS proposal and discussion of links with IOCCP. (*Responsible: Tedesco. Timeframe: Immediate. Financial Implications: None*)  
**COMPLETED**

#### **ACTION ITEM 9**

Submit letter of support for the ICOS Ocean Office from IOCCP SSG. (*Responsible: Tedesco and Tanhua. Timeframe: Immediate. Financial Implications: None*)  
**COMPLETED**

#### **ACTION ITEM 10**

Evaluate options for cooperation between the IOCCP and ICOS Ocean Office. (*Responsible: Tedesco, Tanhua, Telszewski and Hydes. Timeframe: Ongoing. Financial Implications: None*).

#### **ACTION ITEM 11**

Coordinate with Kate Larkin on IOCCP activities. (*Responsible: Tedesco, Telszewski and Larkin. Timeframe: Ongoing. Financial Implications: None*)

### **3.4 RECCAP**

Observations are localized and widely separated in both space and time. As a result, researchers depend on models to characterize, understand, and predict carbon fluxes at regional or global scales. Results differ due to the use of different approaches, modeling strategies, process representation, boundary conditions, initial conditions, and driver data in the models. The Regional Carbon Cycle Assessment and Processes (RECCAP) Project aims to determine approaches to identify the causes of differences and the formulations and approaches that best align with measurements.

Two approaches have been used to understand ocean carbon uptake and storage. One approach is to assess ocean carbon inventory changes in the ocean interior. This is accomplished by reoccupying ocean sections that were surveyed during the 1990s. This work provides information on the decadal scale changes in ocean carbon storage. The second approach is to estimate air-sea CO<sub>2</sub> fluxes. Surface ocean and atmospheric CO<sub>2</sub> partial pressure is measured from ships of opportunity and moorings. These data are used to develop

empirical relationships with properties that can be observed from satellites. Using the time and space coverage of the satellite observations we can generate global fluxes at monthly to decadal time scales. Both the surface observations and the ocean interior observations are used to better understand the controls on the ocean's role in the global carbon cycle.

### **ACTION ITEM 12**

Investigate consistency and agreements on particular products (winds,  $k$ , atmospheric products, SST) used to calculate air-sea flux estimates and generate flux maps. Summarize results. (*Responsible: Schuster. Timeframe: Spring 2012. Financial Implications: None*)

### **3.5 CARBOCHANGE.**

Toste Tanhua introduced CARBOCHANGE Project – “Changes in carbon uptake and emissions by oceans in a changing climate”. This is a new large-scale integrating collaborative research project receiving 7 million Euros funded by the EU's 7<sup>th</sup> Framework Programme for the period March 2011- February 2015. It is coordinated by the Geophysical Institute at the University of Bergen and the Bjerknes Centre for Climate Research, Bergen, Norway. The CARBOCHANGE consortium consists of 28 research institutions from Europe, North America (USA and Canada) and Africa (Morocco and South Africa) with key scientific experts in the field. The kick-off meeting for CARBOCHANGE Project was held in Bergen, Norway on 8-10 March, 2011. CARBOCHANGE builds on the results of the previous EU's 6<sup>th</sup> Framework Programme Integrated Project CARBOOCEAN. Tedesco and Gattuso serve on the International Advisory Board of CARBOCHANGE. Tanhua, Olsen, Monteiro, Gonzalez and Schuster are leaders in the organizing structure of the Project.

CARBOCHANGE will provide the best possible process-based quantification of net ocean carbon uptake under changing climate conditions using past and present ocean carbon cycle changes for a better prediction of future ocean carbon uptake. CARBOCHANGE will combine observational efforts with model simulations and:

- improve the quantitative understanding of key biogeochemical and physical processes through a combination of observations and models,
- upscale new process understanding to large-scale integrative feedbacks of the ocean carbon cycle to climate change and rising carbon dioxide concentrations,
- quantify the vulnerability of the ocean carbon sources and sinks in a probabilistic sense using cutting edge coupled Earth system models under a spectrum of emission scenarios including climate stabilisation scenarios as required for the 5th IPCC assessment report.

The drivers for the vulnerabilities will be identified. The most actual observations of the changing ocean carbon sink will be systematically integrated with the newest ocean carbon models, a coupled land-ocean model, an Earth system model of intermediate complexity, and fully-fledged Earth system models through a spectrum of data assimilation methods as well as advanced performance assessment tools.

Results will be optimal process descriptions and most realistic error margins for future ocean carbon uptake quantifications with models under the presently available observational evidence. The project will deliver calibrated future evolutions of ocean pH and carbonate saturation as required by the research community on ocean acidification in the EU project EPOCA and further projects in this field. The time history of atmosphere-ocean carbon fluxes past, present, and future will be synthesised globally as well as regionally for the

transcontinental RECCAP project. Observations and model results will merge into GEOS/GEO through links with the European coordination action COCOS and will prepare the marine branch of the European Research Infrastructure ICOS. IOCCP will monitor the development of data products within CARBOCHANGE and incorporate them into the global maps and tables.

### ***3.6 A Framework for Ocean Observing***

Albert Fischer, Acting Head of the Global Ocean Observing System (GOOS), presented an update to the SSG on “A Framework for Ocean Observing” (FOO). At the OeamObs09 conference a task team of limited duration was formed to develop recommendations on a framework for ocean observing. Specifically, the task team was asked to develop a framework for an enhanced global sustained ocean observing system over the next decade, integrating new physical, biogeochemical, and biological observations while sustaining present observations, and taking best advantage of existing structures. The Framework is intended to help guide the many different global and regional organizations with a stake in an ocean observing system to work together in a collaborative way for mutual gain. It introduces the concept of Essential Ocean Variables and of assessment and development of readiness for sustained observations; and promotes collaboration in developing requirements, observing networks, and data and information streams. This common language is meant to guide participating organizations and programs in finding and defining their niche and contribution in this larger Framework. The Framework envisioned a biochemical observing panel based on the IOCCP. The IOCCP feels this effort should involve other programs and plans to investigate how best to contribute to the FOO activity through dialogue between the IOCCP, GOOS, IGBP, SCOR, SOLAS, and IMBER.

#### **ACTION ITEM 13**

Initiate conference call between Albert Fischer (GOOS), Ed Urban (SCOR), Toste Tanhua (IOCCP), Eric Salzman (SOLAS), Eileen Hoffman (IMBER) and Sybil Seitzinger (IGBP) to discuss the Framework on Ocean Observing (FOO) prior to the 2012 GOOS Meeting. Share summary of discussion with IOCCP SSG. (*Responsible: Tedesco, Tanhua and Fischer. Timeframe: Spring 2012. Financial Implications: None*)

## **4. Project Updates and Future Activities**

### ***4.1 Surface Ocean CO<sub>2</sub> Atlas (SOCAT)***

Version 1.5 of the Surface Ocean CO<sub>2</sub> Atlas (SOCAT) has been made public on 14 September 2011, here at UNESCO in Paris. This short discussion refers back to the talk ‘Lessons Learnt and a Vision for Future SOCAT’ on 13 September in the Data to Flux workshop (see summary in workshop report), and the public release of SOCAT version 1.5 at the IOCCP/SOLAS/IMBER Surface-Interior Ocean Carbon Synthesis Meeting ([http://www.imber.info/C\\_WG/UNESCO\\_Sept2011/Bakker\\_presentation.pdf](http://www.imber.info/C_WG/UNESCO_Sept2011/Bakker_presentation.pdf)).

The SOCAT global group currently consists of Dorothee Bakker (chair), Benjamin Pfeil, Are Olsen, Chris Sabine, Nicolas Metzl (on long term leave), Steven Hankin, Alex Kozyr, and Maciej Telszewski with Heather Koyuk as an important contributor. There is an urgent need for reinforcing the global group with one or two active scientists.

The role of IOCCP staff member Maciej Telszewski in SOCAT was clarified. Telszewski will spend 30-40% of his time on SOCAT. This may include coordination between the data



managers and LAS staff, contacting PIs for submitting data, and a contribution to a variety of SOCAT activities, but excluding scientific issues and issues relating data quality control.

Nojiri (NIES) kindly offers fund for a SOCAT workshop with 8-10 participants between April 2012 and February 2013 in Japan. The scope, timing and participants of such a workshop need further discussion.

#### **ACTION ITEM 14**

Organize and co-sponsor SOCAT versions 2 & 3 workshops in Tsukuba, Japan. (*Responsible: Telszewski and Nojiri. Timeframe: Summer 2012. Financial Implications: Medium*)

#### **ACTION ITEM 15**

Streamline the communication on SOCAT technical matters. Sponsor an annual 3-day meeting of the SOCAT data managers and LAS staff (Benjamin Pfeil, Alex Kozyr, Heather Koyuk, Steven Hankin, plus 1-2 scientists, as required). (*Responsible: Telszewski. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 16**

Coordinate SOCAT data sharing and storage issues. In particular, accommodating the need for further discussion regarding data submission to WDC Pangea and/or CDIAC. Tanhua will submit a letter of support for CDIAC from the SSG to CARBOCHANGE (*Responsible: Telszewski, Kozyr, Pfeil, Olsen, Bakker, Tanhua. Timeframe: Immediate. Financial Implications: None*)

#### **ACTION ITEM 17**

Organize a conference call to request input from IOCCP and SOCAT regarding which fields need to be updated on the automated data submission form for underway pCO<sub>2</sub> metadata and discrete measurements, and underway pCO<sub>2</sub> form for data submission. Steve Hankin to write the strategy. (*Responsible: Telszewski, Hankin and Kozyr. Timeframe: Spring 2012. Financial Implications: None*)

### ***4.2 Underway pCO<sub>2</sub> Measurements***

Pedro Monteiro led a discussion centered initially on the need to update the global map of VOS sampling. It was then suggested that the surface ocean CO<sub>2</sub> part of the IOCCP web site should become more of a portal for new entrants. This would provide improved information on the setting up and running of pCO<sub>2</sub> systems as well as a list of email or contact details for the experienced pCO<sub>2</sub> users in order to support and encourage new users particularly from developing countries.

The discussion then moved to the action items from the Data-to-Flux Workshop held earlier in the week 12 -13 September 2011. Pedro Monteiro suggested that two meetings were worth exploring as part of the IOCCP mandate: 1) a joint meeting with the Ocean Acidification network with the objectives of identifying the links between SO-CO<sub>2</sub> and OA activities and setting the requirements for and observational network and ancillary variables beyond surface ocean fluxes. 2) a Southern Ocean meeting to specifically focus on the Surface Ocean fluxes that would include both data and empirical methods.

This item was curtailed due to delayed start to the discussion but Monteiro would like to record the sincere thank you to Kathy Tedesco and Maciej Telszewski for their energetic

support in setting and running of the Data-to-Flux Workshop. Its success was owed in no small measure to their energy.

### ***4.3 Repeat Hydrography***

Bernadette Sloyan provided an update on Repeat Hydrography. In 2011, lines SR03, SO40, P13, and SO4P were completed. In addition, the UK occupied a portion of A16N in 2011. At the time of the IOCCP SSG meeting, the US was about to begin the occupation of A10. A hydrographic section in the Mediterranean Sea was occupied by a consortium of Mediterranean nations. It is hoped that a program of repeatedly occupied north-south sections and an east-west section will be established. Toste Tanhua is working to develop the capacity in these nations.

One of the major areas of concern in 2011 was safety in the northwest Indian Ocean due to piracy. As a result, sections I02 and I10 were not occupied in 2011. The Japanese moved this commitment to the Pacific Ocean. This, together with the earlier abandonment of I01W and I07N, has resulted in no repeat section in the region. GO-SHIP committee may need to consider redefining the section requirements (coast-to-coast) in this region. For example, the abandonment of I02 also resulted in the loss of the repeat section I10.

Future Occupations and funding situations.

a) 2012-2014 (committed funding)

During this period repeat hydrographic sections will be occupied in the Southern Ocean (I09S, A12, SR04), Pacific Ocean (P14C, P16S and P02), and Atlantic Ocean (A22, A20, A16N,S).

b) Uncommitted Funding.

The uncommitted sections are mainly in the Pacific and Indian Oceans. GO-SHIP is currently hoping to organize a planning meeting to set the time line for reoccupation of these sections and coordinate national research plans to ensure that the sections in each basin are occupied within a 2 year period.

The SSG also discussed the relationship between GO-SHIP and IOCCP with respect to carbon observations from hydrographic surveys. It was noted that not all ship based surveys that take carbon measurements are part of GO-SHIP repeat hydrography as they do not comply with the GO-SHIP requirements (e.g. coast-to-coast, 50 km horizontal resolution). Currently the IOCCP web site hydrography tab is directed to the GO-SHIP web site. This is not an accurate description of the (routine) ship-based carbon observations. It was decided to change the hydrography tab on the IOCCP web site. This change will be that the IOCCP does not default to the GO-SHIP web site. The IOCCP hydrographic tab will conform to the functionality of the IOCCP tabs. Specifically, the IOCCP hydrography tab will be modified to show a map of all ship based carbon sections (GO-SHIP and other programs) and will provide a link to the GO-SHIP web site. To obtain data the used will be directed to the CDIAC and CCHDO.

### **ACTION ITEM 18**

Encourage repeat hydrography data submission. (*Responsible: Tedesco and Tanhua. Timeframe: Ongoing. Financial Implications: None*)

#### ***4.4 Ocean Interior Data***

Masao Ishii and Toste Tanhua presented an update on Ocean Interior Data activities including PACIFICA and GLODAP2. PACIFICA is due to be released at the PICES meeting in October 2011. Following the release of PACIFICA, the creation of a new interior ocean synthesis product, GLODAPv2, will be produced. This activity is sponsored by the EU projects CARBOCHANGE and COCOS. The main goal of the GLODAPv2 project is to redo some of the secondary quality control of GLODAP to conform to later QC efforts in CARINA and PACIFICA. GLODAPv2 will merge the three existing data products GLODAP, CARINA and PACIFICA (once this is public) and to add data that is not included in any of the three data products, such as recent CLIVAR cruises, but also historical cruises that were overlooked for CARINA. The GLODAPv2 team has identified a large amount of such “new” cruises and started to assemble them in Princeton. The compilation of individual cruises will be finished by mid-2012 by which time the 2<sup>nd</sup> QC will start. The aim is to have the product ready by early 2013.

#### ***4.5 Surface Flux Maps/Data Assimilation***

Ute Schuster presented an update on surface pCO<sub>2</sub> maps estimated by a suite of empirical methods such as neural network or multiple linear regression. Her presentation demonstrated an ever increasing accuracy of these methods. However, based on a disagreement between these methods and in-situ measurements, further methodological improvements are required.

#### ***4.6 Time Series Stations***

Since Melchor Gonzalez was unable to attend, Chris Sabine gave the report on time series coordination. He reviewed some of the history of the IOCCP Time Series work, including the 2008 time series workshop that IOCCP co-hosted with the US OCB program and others in La Jolla, CA USA. OCB hosted related meetings in 2009 on “Observing biogeochemical cycles at global scales with floats and gliders” and 2010 on “Sea Change: Charting the Course for Ecological and Biogeochemical Ocean Time Series Research.”

One of the primary results of the 2008 meeting was recognition that biogeochemical time series are quite varied in the types of platforms used. Although there was an agreement that the community should work with the OceanSITES group, there were many types of observations that should be coordinated, but did not fit in their model. One of these is observations from profiling floats. The 2010 meeting discussed the development of a global array of profiling floats with biogeochemical sensors. That workshop led to the development of a US group called GLOBal Ocean Biogeochemical Experiment (GLOBE) that will try to coordinate a global array of biogeochemical profiling floats. The SSG discussed the issue of whether the IOCCP should work with this group to help with international coordination of biogeochemical profiling floats and if so whether this should be handled through the time series component of IOCCP or whether there should be a new IOCCP component for floats and gliders.

The 2010 meeting in Hawaii focused on the US ship board time series measurements. The final report is still pending from that meeting, but many of the proposed directions for the future will be very relevant for IOCCP. Sabine suggested that the IOCCP consider working with OCB time series group to host an international workshop to compare what types of observations are made and methods used on shipboard time series sites. This workshop would provide an opportunity to compare and evaluate what is being done with the idea of

developing a short list of core parameters that are measured using the standardized methods at all ship based time series sites. It would also provide a venue for evaluating what additional sites are needed and where.

Sabine also reviewed the status of the time series maps and tables on the web. He noted that the web site says it has not been updated since 2007, although the map looks very similar to the CDIAC time series map that says it was updated in December 2010. The time series community was polled in May 2011 for undated information on time series activities. This information needs to be posted to the web and kept updated so the community will see it as a useful resource.

### **ACTION ITEM 19**

Sponsor an ocean time series workshop jointly with OCB. Develop agenda following release of Hawaii workshop report and action items. (*Responsible: Tedesco and Gonzalez. Timeframe: Fall 2012. Financial Implications: Medium*)

### ***4.7 Data and Information Management***

Alex Kozyr provided a performance assessment of the Carbon Dioxide Information Analysis Center (CDIAC). In 2011, CDIAC continued to obtain and process Repeat Hydrography cruise data. All public data from Repeat Hydrography cruises are available at: <http://cdiac.ornl.gov/oceans/RepeatSections/>

New data sets include:

- A13.5\_2010, USA (all data online except pH from Dickson)
- P06\_2009, USA (all data online)
- Arctic Ocean ODEN05, Sweden (all data online)
- TN224\_2008 (P16N), USA (all data online)
- Line P\_2003-2010, Canada

Data needed:

- I08S\_2007 TALK from Dickson
- I05\_2009 TALK, pH from Dickson
- A13.5 pH from Dickson; P21\_2009 Japan
- AR07W\_2002-2010 Canada
- A21\_2005 UK
- S04P\_2011 USA

CDIAC continued to obtain and process the underway pCO<sub>2</sub> data from VOS. All VOS public data are available at: [http://cdiac.ornl.gov/oceans/VOS\\_Program/](http://cdiac.ornl.gov/oceans/VOS_Program/)

New data sets:

- VOS Falstaff 2002-2003, 2005, Germany
- VOS Atlantic Companion 2006-2008, Germany
- VOS OOCL Tianjin 2008-2010, USA
- VOS Pacific Celebes 2007-2010, UK
- VOS GEF Patagonia 1-3 2005-2006, Argentina
- VOS ARGAU 0-5 2000-2005, Argentina
- VOS S/A Agulhas 2008-2010, South Africa

They also continued to obtain and process the data from Moorings and Time-series Project. All public data are available at: <http://cdiac.ornl.gov/oceans/Moorings/>

New data sets:

- CCE1\_122W\_33N 2008-2010, USA Sabine
- MOSEAN\_158W\_23N 2004-2007, USA Sabine
- TAO\_125W 2004-2008, USA Sabine
- TAO\_140W 2004-2007, 2009 USA Sabine
- TAO\_155W 2008, USA Sabine
- TAO\_170W 2006-2009, USA Sabine
- WHOTS\_158W\_22N 2008-2009, USA Sabine
- Papa\_145W\_50N 2007-2008, USA Sabine
- Stratus\_85W\_20S 2006-2010, USA Sabine
- KEO\_145E\_32N 2007-2009, USA Sabine
- JKEO\_147E\_38N 2007, USA Sabine
- BTM\_64W\_32N 2005-2007, USA Sabine

and CO<sub>2</sub> – related data from Global Coastal Project. All Global Coastal Project public data are available at: <http://cdiac.ornl.gov/oceans/Coastal/>

New data sets:

- AOML East Coast Cruise 2007, USA Wanninkhof;
- PMEL West Coast Cruise 2007, USA Feely

New publication include:

1. Takahashi, T., S.C. Sutherland, and A. Kozyr. 2011. Global Ocean Surface Water Partial Pressure of CO<sub>2</sub> Database: Measurements Performed During 1957–2010 (Version 2010). ORNL/CDIAC-159, NDP-088(V2010). Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, doi: 10.3334/CDIAC/otg.ndp088(V2010).

[http://cdiac.ornl.gov/oceans/LDEO\\_Underway\\_Database/](http://cdiac.ornl.gov/oceans/LDEO_Underway_Database/)

2. Program Developed for CO<sub>2</sub> System Calculations CO2calc: A User-Friendly Seawater Carbon Calculator for Windows, Mac OS X, and iOS (iPhone). December 2010.

[http://cdiac.ornl.gov/oceans/CO2SYS\\_calc\\_MAC\\_WIN.html](http://cdiac.ornl.gov/oceans/CO2SYS_calc_MAC_WIN.html)

#### **4.8 IPCC**

Yukihiro Nojiri updated the group on the developments in preparation to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), specifically related to ocean acidification. AR5 will include comprehensive coverage of ocean acidification and its impacts, including potential feedbacks to the climate system. To support ongoing AR5 assessment efforts, Working Group II and Working Group I (WGII and WGI) of the IPCC held a joint Workshop on Impacts of Ocean Acidification on Marine Biology and Ecosystems in Okinawa, Japan, from 17 to 19 January 2011.

The workshop convened experts from the scientific community, including WGII and WGI AR5 authors and review editors, to synthesise scientific understanding of changes in ocean chemistry due to increased CO<sub>2</sub> and of impacts of this changing chemistry on marine organisms, ecosystems, and ecosystem services. Nojiri summarised the scientific content and perspectives presented and discussed during the workshop based on the workshop report. He noted that discussions revolved around three core topics: (i) the changing chemistry of the

oceans, (ii) impacts of ocean acidification for individual organisms, and (iii) scaling up responses from individual organisms to ecosystems.

Nojiri then reminded the group of essential deadlines for AR5 process. The group noted that publications related to several IOCCP activities (e.g. SOCAT) have to meet those deadlines in order to be implemented in AR5. Sabine informed the group that registration site for the Expert Review of the First Order Draft of the WGI AR5 has been released and is available from the WGI web site at: <https://fod.ipcc.unibe.ch/registration/>.

#### **ACTION ITEM 20**

Share the IPCC Expert Reviewer link with the ocean carbon community who might be interested in serving as Expert Reviewers. (*Responsible: Tedesco. Timeframe: Immediate. Financial Implications: None*)

#### **ACTION ITEM 21**

Distribute new definition of ocean acidification for AR5 to the community. (*Responsible: Tedesco. Timeframe: Immediate. Financial Implications: None*)

### ***4.9 Ocean Acidification***

Kathy Tedesco presented an update on the Third Symposium on “The Ocean in a High-CO<sub>2</sub> World” to be held on 24-27 September 2012 in Monterey, California, USA. The symposium aims to attract more than 300 of the world’s leading scientists to discuss the impacts of ocean acidification on marine organisms, ecosystems, and biogeochemical cycles. It will also cover socioeconomic consequences of ocean acidification, including policy and management implications.

The symposium is sponsored by the Scientific Committee on Oceanic Research (SCOR), Intergovernmental Oceanographic Commission (IOC) of UNESCO, and International Geosphere-Biosphere Programme (IGBP). The International Planning Committee is led by Prof. Dr. Ulf Riebesell of the Leibniz Institute of Marine Sciences (Germany), and the local organization is led by Dr. Jim Barry of Monterey Bay Aquarium Research Institute and supported by a consortium of institutions.

The symposium is the third in a series and will build on the successes of the Paris and Monaco symposia in 2004 and 2008, respectively. The Paris meeting was seminal in identifying the magnitude of ocean acidification for marine ecosystems and the outcomes of the Monaco symposium, focusing on the advances in knowledge of the affects on marine organisms, also made an impact on a broader audience through a Summary for Policymakers on Ocean acidification and the Monaco Declaration.

The international planning committee met in December 2010 in Monterey, CA, USA to begin development of the symposium scientific program. The workshop will consist of plenary presentations by invited speakers, parallel, and poster sessions. In addition, there will be education and outreach activities on the final day of the symposium.

The Plenary talks include

- The history of ocean acidification science - P Brewer
- Changes in ocean carbonate chemistry since the Industrial Revolution - R Zeebe
- Rates of change of ocean acidification: Insights from the paleorecord - D Schmidt
- Interactions of ocean acidification with physical climate change - L Bopp

- Responses of organisms and ecosystems to multiple environmental stressors (ocean acidification, hypoxia, temperature, UV, etc.) - H-O Poertner
- Acclimation and adaptation: Genomics, physiology, and behavior - G Hofmann
- Ecosystem change and resilience in response to ocean acidification - S Widdicombe
- Biogeochemical consequences of ocean acidification and feedbacks to the Earth system - R Matear
- Understanding the economics of ocean acidification - L Brander
- Policy and governance: Implications, solutions, and barriers – V Galaz
- Impacts of ocean acidification on foodwebs and fisheries - B Fulton

The Parallel Presentation topics include

- Detection and attribution of ocean acidification changes
- Effects of ocean acidification on nutrient and metal speciation
- New developments in measuring and observing ocean acidification and its effects
- Regional impacts of ocean acidification
- Effects of ocean acidification on calcifying organisms
- New concerns in ocean acidification research

Information about the Third "Ocean in a High CO<sub>2</sub> World Symposium" can be found at [www.highCO2-iii.org](http://www.highCO2-iii.org). Information about previous symposia, ocean acidification news, and research activities can be found at [www.ocean-acidification.net](http://www.ocean-acidification.net).

The group discussed the conclusion of the 4<sup>th</sup> Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) that ocean acidification has the potential for major impacts in coastal areas. Wind-driven, seasonal upwelling of subsurface waters in coastal margins brings CO<sub>2</sub>-enriched waters onto the shelf and, in some instances, into the surface ocean. This water contains a high level of CO<sub>2</sub> resulting from natural respiration processes in the subsurface layers and is also significantly contaminated with anthropogenic CO<sub>2</sub>. Some of the world's most productive fisheries are located within coastal zones. As a result impacts on marine food webs caused by ocean acidification could be more severe than previously anticipated. The IOCCP plans to organize a workshop focused on increasing observations of the carbonate system in coastal waters to better monitor its seasonal and interannual variability in order to mitigate ocean acidification impacts on coastal ecosystems.

### **ACTION ITEM 22**

Organize and sponsor a coastal meeting to gather data and bring the OA and coastal community together. Discuss with Simone Alin. (*Responsible: Tedesco, Tanhua, Gattuso, and Alin. Timeframe: Spring/Summer 2012. Financial Implications: Medium*)

## **5. Comparison Activities**

### ***5.1 Alliance for Coastal Technologies***

Chris Sabine updated the SSG on the recent and future activities of the U.S. ACT group. ACT completed a moored pCO<sub>2</sub> evaluation in 2010. They evaluated the Battelle MAPCO<sub>2</sub>, Contros, SAMI, and ProOceanus systems with one month studies in Puget Sound, WA USA and Hawaii USA. The reports are available on the ACT website (<http://www.act-us.info/evaluations.php#pco2>). They are also currently performing a 6 month evaluation of these same sensors on a mooring in the Gulf of Alaska. In 2012 they have plans to evaluate

pH sensors. The details of how this evaluation will work are still being discussed. Chris Sabine is on the technical committee for the ACT pH evaluation and will keep the IOCCP informed of its progress.

### **ACTION ITEM 23**

Produce an IOCCP report on the results of the Intercomparison Experiment with suggestions from the group. (*Responsible: Nojiri. Timeframe: March 2012. Financial Implications: None*)

## **6. Project Office**

Program support for the IOCCP is provided by NSF through a grant to SCOR. A new continuing grant was approved beginning 1 October 2009 and provides \$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 start of each year. The IOCCP successfully completed all action items from the 2010 IOCCP SSG meeting, including sponsorship of several workshops such as the “IOCCP Surface Ocean CO<sub>2</sub> Data-to-Flux Workshop” and the “SOLAS-IMBER-IOCCP Surface-Interior Meeting”. The IOCCP will begin 2012 with a budget of about \$65,000 for activities. Given this level of available funding for 2012, Action Items are assigned a financial implication level based on “low” (<\$5,000), “medium” (<\$15,000), and “high” (>\$15,000).

### **ACTION ITEM 24**

Update IOCCP SSG Terms of Reference for possible inclusion of developing nations. Discuss with Ed Urban. (*Responsible: Tedesco, Tanhua and Urban. Timeframe: Spring 2012. Financial Implications: None*)

### **ACTION ITEM 25**

Gather names of coastal carbon and platform experts for possible inclusion in the SSG. Discuss with Ed Urban. To be discussed at 2012 SSG meeting. (*Responsible: Tedesco, Tanhua and IOCCP SSG. Timeframe: Spring 2012. Financial Implications: None*)

### **ACTION ITEM 26**

Coordinate repeat hydrography, surface CO<sub>2</sub> and ocean time series maps and tables at CDIAC with IOCCP Web-site. (*Responsible: Telszewski and Kozyr. Timeframe: Ongoing. Financial Implications: None*)

### **ACTION ITEM 27**

Ask SSG members to check how their activities are presented on the Web-site on a regular basis. Provide feedback to the IOCCP. (*Responsible: Telszewski and IOCCP SSG. Timeframe: Ongoing. Financial Implications: None*)

### **ACTION ITEM 28**

Overhaul of IOCCP Web-sites. Tasks include creating 2 links under global maps for hydrography -GO-SHIP and Other Cruises. Create a sub-page describing the standard operating procedures for setting up a surface VOS line including a list of contacts and links. Include summary information under each activity. (*Responsible: Telszewski and Monteiro. Timeframe: Ongoing. Financial Implications: None*)

### **ACTION ITEM 29**

Organize the 7<sup>th</sup> IOCCP SSG meeting. (*Responsible: Tedesco, Telszewski and Tanhua. Timeframe: Summer 2012. Financial implications: Medium to High*)



## **IV. Action Item List 2012**

### **ACTION ITEM 1**

Prepare a workshop report. (*Responsible: Telszewski and Tedesco. Timeframe: Spring 2012. Financial Implications: None*)

### **ACTION ITEM 2**

Contact Andrew Lenton, new chair of SIC WG1, requesting a list of parameters they would like to include and requirements for widening of observational network beyond pCO<sub>2</sub> (e. g., DIC, TA, NO<sub>3</sub>, O<sub>2</sub>, O<sub>2</sub>-Ar). (*Responsible: Telszewski and Lenton. Timeframe: Spring 2012. Financial Implications: None*)

### **ACTION ITEM 3**

Provide feedback to Andrew Lenton regarding potential role of the IOCCP following review of the list. (*Responsible: Telszewski, Tedesco and IOCC SSG. Timeframe: Summer 2012. Financial Implications: None*)

### **ACTION ITEM 4**

Coordinate with SIC WG2 on the role of IOCCP in the conclusion of PACIFICA, estimates of anthropogenic carbon, and coastal margins. (*Responsible: Tedesco and Gruber. Timeframe: Ongoing. Financial Implications: Low*)

### **ACTION ITEM 5**

Coordinate with SIC WG2 on global synthesis of POC and DOC. Provide data and information to the community. Possibly co-sponsor a POC and DOC intercomparison exercise. Discuss with Denis Hansell to see if this is necessary. (*Responsible: Tedesco and Gruber. Timeframe: Fall 2012. Financial Implications: Medium*)

### **ACTION ITEM 6**

Determine interfaces between the OA International Coordination Office and IOCCP. (*Responsible: Tedesco and Gattuso. Timeframe: Ongoing. Financial Implications: None*)

### **ACTION ITEM 7**

Work with SOLAS/IMBER Carbon Working Group chairs to select appropriate SSG representatives to serve on the SIC Working Groups. (*Responsible: Tanhua, Tedesco, Lenton, Gruber, Gattuso. Timeframe: Ongoing. Financial Implications: None.*)

### **ACTION ITEM 8**

Provide Feedback to David Hydes regarding ICOS proposal and discussion of links with IOCCP. (*Responsible: Tedesco. Timeframe: Immediate. Financial Implications: None*)  
**COMPLETED**

### **ACTION ITEM 9**

Submit letter of support for the ICOS Ocean Office from IOCCP SSG. (*Responsible: Tedesco and Tanhua. Timeframe: Immediate. Financial Implications: None*)  
**COMPLETED**

### **ACTION ITEM 10**

Evaluate options for cooperation between the IOCCP and ICOS Ocean Office. (*Responsible: Tedesco, Tanhua, Telszewski and Hydes. Timeframe: Ongoing. Financial Implications: None.*)

#### **ACTION ITEM 11**

Coordinate with Kate Larkin on IOCCP activities. (*Responsible: Tedesco, Telszewski and Larkin. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 12**

Investigate consistency and agreements on particular products (winds,  $k$ , atmospheric products, SST) used to calculate air-sea flux estimates and generate flux maps. Summarize results. (*Responsible: Schuster. Timeframe: Spring 2012. Financial Implications: None*)

#### **ACTION ITEM 13**

Initiate conference call between Albert Fischer (GOOS), Ed Urban (SCOR), Toste Tanhua (IOCCP), Eric Salzman (SOLAS), Eileen Hoffman (IMBER) and Sybil Seitzinger (IGBP) to discuss the Framework on Ocean Observing (FOO) prior to the 2012 GOOS Meeting. Share summary of discussion with IOCCP SSG. (*Responsible: Tedesco, Tanhua and Fischer. Timeframe: Spring 2012. Financial Implications: None*)

#### **ACTION ITEM 14**

Organize and co-sponsor SOCAT versions 2 & 3 workshops in Tsukuba, Japan. (*Responsible: Telszewski and Nojiri. Timeframe: Summer 2012. Financial Implications: Medium*)

#### **ACTION ITEM 15**

Streamline the communication on SOCAT technical matters. Sponsor an annual 3-day meeting of the SOCAT data managers and LAS staff (Benjamin Pfeil, Alex Kozyr, Heather Koyuk, Steven Hankin, plus 1-2 scientists, as required). (*Responsible: Telszewski. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 16**

Coordinate SOCAT data sharing and storage issues. In particular, accommodating the need for further discussion regarding data submission to WDC Pangea and/or CDIAC. Tanhua will submit a letter of support for CDIAC from the SSG to CARBOCHANGE (*Responsible: Telszewski, Kozyr, Pfeil, Olsen, Bakker, Tanhua. Timeframe: Immediate. Financial Implications: None*)

#### **ACTION ITEM 17**

Organize a conference call to request input from IOCCP and SOCAT regarding which fields need to be updated on the automated data submission form for underway  $pCO_2$  metadata and discrete measurements, and underway  $pCO_2$  form for data submission. Steve Hankin to write the strategy. (*Responsible: Telszewski, Hankin and Kozyr. Timeframe: Spring 2012. Financial Implications: None*)

#### **ACTION ITEM 18**

Encourage repeat hydrography data submission. (*Responsible: Tedesco and Tanhua. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 19**

Sponsor an ocean time series workshop jointly with OCB. Develop agenda following release of Hawaii workshop report and action items. (*Responsible: Tedesco and Gonzalez. Timeframe: Fall 2012. Financial Implications: Medium*)

#### **ACTION ITEM 20**

Share the IPCC Expert Reviewer link with the ocean carbon community who might be interested in serving as Expert Reviewers. (*Responsible: Tedesco. Timeframe: Immediate. Financial Implications: None*)

#### **ACTION ITEM 21**

Distribute new definition of ocean acidification for AR5 to the community. (*Responsible: Tedesco. Timeframe: Immediate. Financial Implications: None*)

#### **ACTION ITEM 22**

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Produce an IOCCP report on the results of the Intercomparison Experiment with suggestions from the group. (*Responsible: Nojiri. Timeframe: March 2012. Financial Implications: None*)

#### **ACTION ITEM 24**

Update IOCCP SSG Terms of Reference for possible inclusion of developing nations. Discuss with Ed Urban. (*Responsible: Tedesco, Tanhua and Urban. Timeframe: Spring 2012. Financial Implications: None*)

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Gather names of coastal carbon and platform experts for possible inclusion in the SSG. Discuss with Ed Urban. To be discussed at 2012 SSG meeting. (*Responsible: Tedesco, Tanhua and IOCCP SSG. Timeframe: Spring 2012. Financial Implications: None*)

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Coordinate repeat hydrography, surface CO<sub>2</sub> and ocean time series maps and tables at CDIAC with IOCCP Web-site. (*Responsible: Telszewski and Kozyr. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 27**

Ask SSG members to check how their activities are presented on the Web-site on a regular basis. Provide feedback to the IOCCP. (*Responsible: Telszewski and IOCCP SSG. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 28**

Overhaul of IOCCP Web-sites. Tasks include creating 2 links under global maps for hydrography -GO-SHIP and Other Cruises. Create a sub-page describing the standard operating procedures for setting up a surface VOS line including a list of contacts and links. Include summary information under each activity. (*Responsible: Telszewski and Monteiro. Timeframe: Ongoing. Financial Implications: None*)

#### **ACTION ITEM 29**

Organize the 7<sup>th</sup> IOCCP SSG meeting. (*Responsible: Tedesco, Telszewski and Tanhua. Timeframe: Summer 2012. Financial implications: Medium to High*)

Financial Implications

Low: <\$5K / Medium: \$5-15K / High: >\$15K