

REPORT OF SECTION ON CARBON AND CLIMATE



The meeting of the Section on *Carbon and Climate* (hereafter CC-S) was held from 09:00–17:00 hours on October 28, 2007. Drs. James Christian and Toshiro Saino co-chaired the meeting attended by 13 members and 12 observers (*CC-S Endnote 1*). The draft agenda was reviewed and adopted unanimously (*CC-S Endnote 2*).

Membership (Agenda Item 2)

The new member from Canada, Dr. Sophia Johannessen, was introduced to the group. Appointment of additional members from Japan and China was discussed but will be left to the national delegates to finalize. There may be new CC-S members added later to reflect an intensified focus on the biological impacts of ocean acidification.

Methods manual for CO₂ measurements (Agenda Item 3)

Dr. Christian provided an update on the progress of the “*Guide to Best Practices for Ocean CO₂ Measurements*”. The editors, Dr. Christian, Andrew Dickson and Christopher L. Sabine, and the PICES Secretariat have finished editing the Guide, and it will be published this year as PICES Special Publication No. 3/IOCCP Report No. 8. This publication has been made possible due to support by PICES, International Ocean Carbon Coordination Project (IOCCP) co-sponsored by SCOR (Scientific Committee on Oceanic Research) and IOC (Intergovernmental Oceanographic Commission of UNESCO), and the Carbon Dioxide Information Analysis Center (CDIAC). Interactive web-based community review was open for approximately 3 months on a server at CDIAC, and many CC-S members participated.

It was suggested that more than the originally planned 800 hard copies of the Guide should be printed, and that an electronic version be hosted

at CDIAC. The Guide is envisioned as an evolving document, updated where necessary. Comments and suggestions for use in preparing future versions are welcome.

There was some discussion of translating the Guide into other languages but no decisions were made. A partial Japanese translation of the 1994 edition exists. The consensus was that this version should remain online at CDIAC, but be clearly marked that it is not the current version.

Topic Session at PICES XVI and plans for publication (Agenda Item 4)

A 1-day BIO/POC Topic Session on “*Decadal changes in carbon biogeochemistry in the North Pacific*” (S2) was held at PICES XVI. This was the first scientific session sponsored by CC-S. Drs. Christian and Saino served as co-convenors and Dr. Taro Takahashi (U.S.A.) was the invited speaker. Two dozen abstracts from all PICES member countries were submitted (for details see the *Session Summaries* chapter of this Annual Report). Selected papers from this session will be published in 2009 as a special section in a regular issue of *Journal of Oceanography*. Dr. Saino, Editor of the journal, will coordinate this process and select the Guest Editors.

Reports on collaborating organizations and agencies (Agenda Item 5)

Reports were given on several national and international programs relevant to the mandate of CC-S: IOCCP, Global Carbon Project (GCP) and CLIVAR/CO₂ Repeat hydrography by Dr. Sabine; U.S. Ocean and Biogeochemistry Group (US-OCB) by Dr. Richard A. Feely; Japan-SOLAS and Japan-IMBER by Dr. Saino, and CarboOcean by Dr. Robert Key. Dr. Feely also gave an extensive report from the U.S. Scoping Workshop on “*Ocean acidification research*” held October 9–11, 2007, in San Diego.

Data integration for synthesis (Agenda Item 6)

The carbon data synthesis has been a key focus of CC-S activities, and significant progress has been made in the past year. Drs. Key (U.S.A.) and Nobuo Tsurushima (Japan) were invited to attend the meeting as observers. Dr. Key has extensive experience in assembling integrated data sets for GLODAP (Global Ocean Data Analysis Project) and CARINA (Carbon dioxide in the Atlantic Ocean). Dr. Tsurushima was selected at PICES XV to lead the synthesis effort for the Northwest Pacific. Dr. Masao Ishii (Japan) was also invited but was unable to attend. He distributed a proposal for a Data Synthesis Implementation Plan which was adopted with revisions (*CC-S Endnote 3*).

Presentations from Drs. Alexander Kozyr and Toru Suzuki detailed the progress of their respective Data Centers, CDIAC and MIRC (JHA's Marine Information Research Center). Dr. Suzuki provided extensive and detailed statistics regarding the spatial and temporal distribution of data, which suggests that this data set promises substantial progress over what is currently available in understanding interannual-to-interdecadal variability. Dr. Suzuki has catalogued, or been promised by the Principal Investigator, 186 cruises, not including those where only pH was measured, and currently holds in his possession the data from around 50% of these cruises. Dr. Kozyr has a somewhat smaller inventory but has actual possession of 100% of the data catalogued.

The consensus of the Section was that there needs to be a date to close data submission, which was tentatively set as January 2009.

Dr. Key expressed the opinion that most of the cross-calibration work for synthesis could not begin until the raw data set was finalized (*i.e.*, until data submission was closed). The members did not see a need to set a format for metadata.

The exact strategy for second level quality control (second QC) was not determined. Regional sub-group leaders have been appointed (see the 2006 CC-S Annual Report) but the membership in these groups is not yet determined. Regional sub-groups will need to meet to determine strategy for second QC.

Future activities (Agenda Item 7)

Next year's PICES Annual Meeting will take place very close to the international symposium on "*The ocean in a high CO₂ world – II*" to be convened October 6–8, 2008, in Monaco. It was suggested that the CC-S meeting could be held there instead of at PICES XVII in Dalian, China, as it is likely that some members would be unable to attend both events.

The Section decided not to have a Topic Session at PICES XVII. A Topic Session will be planned for PICES XVIII (October 2009), with ocean acidification as the tentative theme.

Terms of reference (Agenda Item 8)

The CC-S terms of reference were revised slightly to reflect an intensified focus on ocean acidification (*CC-S Endnote 4*). The revisions were presented at the POC and BIO meetings later in the week.

CC-S Endnote 1**Participation list**Members

James Christian (Canada, Co-Chairman)
 Richard A. Feely (U.S.A.)
 Hernan Garcia (U.S.A.)
 Sophia Johanessen (Canada)
 Alex Kozyr (U.S.A.)
 Kitack Lee (Korea)
 Lisa A. Miller (Canada)
 Tsuneo Ono (Japan)
 Christopher L. Sabine (U.S.A.)
 Toshiro Saino (Japan, Co-chairman)
 Toru Suzuki (Japan)
 Shuichi Watanabe (Japan)
 Yutaka Watanabe (Japan)

Observers

Alexander Bychkov (PICES)
 Fei Chai (U.S.A.)
 Michael J. Dagg (U.S.A.)
 Robert Key (U.S.A.)
 Skip McKinnell (PICES)
 Akira Nakadate (Japan)
 Yukihiro Nojiri (Japan)
 Taro Takahashi (U.S.A.)
 Takayuki Tokieda (Japan)
 Atsushi Tsuda (Japan)
 Hiromichi Tsumori (Japan)
 Nobuo Tsurushima (Japan)

CC-S Endnote 2**CC-S meeting agenda**

1. Welcome, aims of the meeting, approval of agenda
2. Discussion of CC-S membership and introduction of new members
3. Methods manual for CO₂ measurements
4. Topic Session at PICES XVI and plans for publication
5. Reports on collaborating organizations and agencies
6. Data integration for synthesis: What progress has been made, what still needs to be done? Are the original objectives and guiding principles still relevant or need revisions? What do different member delegations need to bring their data into the synthesis?
7. Future activities
8. Discussion of revised Terms of Reference

CC-S Endnote 3**Data Synthesis Implementation Plan**Overall goals

- Create a database of water column CO₂-related data for the Pacific;
- Produce an internally consistent database that has gone through a second level quality control (second QC). Here, we define the first level QC as QC by a PI, including flagging of data, and second level QC as activities to correct for the offset among cruises or stations by way of cross-over, MLR analyses, internal consistency among carbon parameters, *etc*;
- Bring together research groups that measure water-column CO₂-related parameters in the Pacific;
- Provide a forum for regional working groups for data collection and analysis;
- Estimate anthropogenic CO₂ and variability of ocean carbon chemistry in the Pacific from regional-to-basin scales;
- Provide data for studies of ocean carbon chemistry.

Area

- The North Pacific, Equatorial Pacific, South Pacific, and their marginal seas;
- Pacific sector of the Southern Ocean, including south of Australia. These data may be shared with the Southern Ocean Carbon Synthesis group of CARBOOCEAN led by M. Hoppema (AWI, Germany).

Data

- Hydrographic and chemical data sets including DIC, alkalinity, pH, pCO₂, DOC, ¹³C, ¹⁴C, nutrients, oxygen, and transient tracers such as CFCs, CCl₄, SF₆, etc. ³H/³He, chlorophyll + phaeopigment;
- Readable electronic format, preferably WHP exchange format with WHP quality flags and version (update) information (column order cannot be standardized);
- Metadata, such as method of analysis and information on quality control, and the list of the related publications (citing these helps the contributing PIs).

Collection and archive

- Open data sets available from Data Centers such as CCHDO, CDIAC, WDCGG, and websites of organizations and programs (PIs must agree to make their data public, following the first QC);
- Data not included in the GLODAP database;
- Data sets will be stored at MIRC and/or CDIAC and prepared for the second level QC;
- Working synthesis database will be

developed and available only to the PIs who submitted a data set, and synthesis regional sub-groups of PICES CC-S. Modelers who are interested in using the data can access the database by contacting a sub-group member;

- PICES database will be published and will be open to the public through participating Data Centers;
- In PICES database publications, credit will be given to all PIs who submitted data sets.

Action items

- Establish PICES database regional sub-groups for the Northeast Pacific, Northwest Pacific, Equatorial Pacific, and South Pacific;
- Toru Suzuki (MIRC) and Alexander Kozyr (CDIAC) are responsible for PICES database cruise and data inventory;
- Target date to compile the first version of the data set is January 1, 2009;
- Regional working groups will gather as much data as possible prior to September 1, 2008 deadline. The GLODAP/CARINA method for the second QC will be used as a primary model. Details of how this will be carried out and the final stages of data-gathering will be discussed at the CC-S meeting in the fall of 2008;
- Second QC will require additional meetings of regional sub-groups or full CC-S. Funds will be requested from PICES and IOCCP to support this.

CC-S Endnote 4

Revised terms of reference for the Section on *Carbon and Climate*

Suggested changes appear in bold.

1. Coordinate and encourage ongoing and planned national and international syntheses of carbon cycle research studies in the North Pacific and, where necessary and appropriate, for the larger Pacific basin;
2. Ensure effective two-way communication with other international scientific groups that have a responsibility for coordination of ocean carbon studies, such as the International Ocean Carbon Coordination

- Project (IOCCP), CLIVAR/CO₂ Repeat Hydrography and the SOLAS/IMBER implementation group for carbon research;
3. Review the existing information on carbon cycling in the North Pacific, including anthropogenic carbon, the biological pump, impacts **of ocean acidification** on marine biota, and possible feedbacks to atmospheric greenhouse gases; identify gaps in our knowledge, and make prioritized recommendations for future research.

4. Periodically review the status of the methodology of CO₂ measurements including the preparation of standards and reference materials, and advise on inter-calibration and quality control procedures;
5. Identify suitable data sets on the oceanic CO₂ system in the Pacific region as they become available, and recommend the mechanisms of data and information exchange;
6. Carry out and publish (in the refereed literature) basin-scale syntheses of carbon cycling in the North Pacific, including new data whenever appropriate, and encourage scientific interpretation of these evolving data sets;
7. Organize symposiums, workshops, or annual meeting sessions on the **carbon cycle, ocean acidification**, and climate studies in the North Pacific.

