

THE IOCCP CONVEYOR



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A Word from the Editor

Dear Ocean Carbon Community,

Happy New Year!

Another year of challenges, successes and occasional failure has just started. As you refine your goals for the coming year, remember that IOCCP is always here to help. International coordination of ocean observing networks is an ever more complex task and our New Year's resolution is to help connect efforts of various elements of the global ocean observing system so that "our" biogeochemical observations can be

made more cost-efficiently, can cover larger areas more frequently and last but not least can be more easily combined with data gathered by others.

As we reflect on the past year, it's obvious that the IOCCP has undergone several organizational changes but our core mission and key directions stay the same. This issue of the IOCCP Conveyor sums up major ongoing community undertakings and provides an update on some changes that we have been through in 2012.

We are looking forward to a fruitful collaboration in 2013!

Update on the Surface Ocean CO₂ Atlas

The Surface Ocean CO₂ Atlas (SOCAT) was publicly released 16 months ago with 6.3 million global surface ocean CO₂ observations made around the world from research vessels, commercial ships and mooring between 1968 and 2007. This dataset, put together by approximately 50 international seagoing marine carbon scientists and data managers, is available at the [SOCAT website](#) together with ancillary documentation including metadata files, quality control protocols, software description, a list of [publications describing the SOCAT process](#) and [workshop reports](#) providing mostly technical insight into SOCAT developments.

Almost 5 years of work on SOCAT project has revealed major room for improvement in the way that scientists report and document and quality control their data. Also significant amount of additional data for years 1968-2007 and new data for years 2008-2011 was made available to the SOCAT team over the last 16 months. The SOCAT community, with strong support from IOCCP, has been addressing both issues and we hope that we will be able to reveal the results in the first half of 2013. The group met three times over the last year and had several virtual meetings to work on the automation of the data submission and quality control procedures as well as on the quality control of the data submitted since the release of the first version of SOCAT (SOCATv1.5, 14 September 2011)

The quality control procedures for the second version of SOCAT (SOCATv2) are mostly finished and the dataset will expand by approximately 50% in terms of number of cruises as well as number of data points.

The time coverage will be expanded through December 2011. The procedures for automation of data submission and data quality control are being finalized and are hoped to be implemented in the third version of SOCAT (SOCATv3).

The SOCAT community and the IOCCP would like to thank all the contributors for their time and effort to date. At the same time we would like to strongly encourage marine carbon scientists to promptly submit their surface water CO₂ data with accompanying documentation for inclusion in future SOCAT releases.

Global Intercomparability in a Changing Ocean: An International Time-Series Methods Workshop

A Global Intercomparability in a Changing Ocean: An International Time-Series Methods Workshop was jointly convened by IOCCP and the U.S. Ocean Carbon & Biogeochemistry (OCB) Program. The workshop was held on November 28-30, at the Bermuda Institute for Ocean Sciences (BIOS), home of the Bermuda Atlantic Time-series Study (BATS), one of the longest ship-based biogeochemical time-series. The workshop was the third in a series of workshops focusing on ship-based biogeochemical time-series that started in 2008 with the “Changing Times: An International Ocean Biogeochemistry Time-series Workshop”; this was followed by the “Sea Change: Charting the course for ecological and biogeochemical ocean time series research” workshop in 2010. However, unlike the previous two, this workshop focused specifically on the methods employed by each time-series with the aim of enhancing data comparability between

sites. In order to monitor and differentiate natural cycles and human-driven changes in the global oceans, it is important that time-series methodologies (sampling and analytical protocols) be transparent, consistent, and inter-comparable. Despite the fact that many biogeochemical time-series have used the JGOFS protocols as a basis for their sampling and analytical methodologies, several adaptations have been made based on local oceanographic conditions (e.g., open ocean vs. coastal) and several other factors. To date, no thorough intercomparison among time-series methodologies has been conducted at a global scale. The workshop goals, aimed at addressing this important issue, included the following:

- ❖ Review current oceanographic time-series core sampling and analytical methodologies and rationale behind protocol differences
- ❖ To the extent possible, attempt to define standardized methods applicable across time-series
- ❖ Attempt to reconcile differences in variable nomenclature
- ❖ Examine new techniques available for more accurate and simplified measurements
- ❖ Generate a list of suggestions on how automated sensors may improve the type and accuracy of core measurements taken at time-series sites
- ❖ Coordinate a best practices publication on sampling and measurement protocols to facilitate data inter-comparison across time-series sites

With representation from 17 countries and 33 time-series around the globe, this workshop convened scientists and

technicians who not only possessed an understanding of the scientific goals and methodological rationale at their sites, but they also had ample hands-on experience with sample collection and analyses. To set the stage for in-depth smaller group discussions, the workshop opened with a series of plenary overview talks that highlighted scientific advances and insights derived from time-series data, as well as the logistical challenges of maintaining these critical community resources. The workshop then broke into smaller groups to discuss and compare sampling protocols and analytical methods across the time-series sites. There were nine different working groups, each focusing on a different set of biogeochemical parameters, including Pigments, In Line Measurements, CTD Parameters and Discrete Calibrations, Inorganic Macro- and Micronutrients, Biomass, Carbonate System, Rates, Trap Fluxes, and Organic Matter.

Outcomes and recommendations

Below are some of the key outcomes and recommendations of the workshop; this is a very brief summary of the main points discussed. The working groups were very thorough and examined the methodologies carefully, and the detailed recommendations of these discussions will be published in the final report.

- ❖ The first clear recommendation from the workshop is that there is a sore need for metadata. While the methods described are generally very similar, there are subtle differences that may affect data inter-comparability. It is critical that this information be reported via the metadata. The workshop organizers will revise and expand the master site compilation to include more detailed information about

the methods; workshop participants committed themselves to providing this additional requested material following the workshop. Many sites also have a long history of testing their methods for improvement; it is suggested that all of the information be made available, so as to better determine why some things are done the way they are (less anecdotal and more objective - e.g. order of sample drawing, time for sampling certain variables, etc).

- ❖ In the interest of improving internal consistency within individual time-series as well as intercomparability among multiple time-series, some of the working groups suggested simple and informative *within sites* and *across time-series* methodological experiments that could be carried out by any of the participating sites.
- ❖ Time-series, especially in developing countries, are doing the best they can with limited resources. The workshop established a network of biogeochemical time-series through which sites with questions or problems can contact fellow colleagues that have worked in similar situations/environments and who can provide assistance.
- ❖ The workshop web portal and email list will be transformed into an active web-based network of international time-series information that will be expanded to include other interested shipboard biogeochemical time-series.
- ❖ The workshop encouraged an atmosphere of data sharing and when possible, an open-data policy. This new international time-series network will help better disseminate existing data by

establishing a web portal with links to time-series PIs or data repositories.

The full workshop report will serve as a best practices road map for ship-based, biogeochemical time-series to facilitate data intercomparability across sites and ocean basins. This report will include:

- Tiered method recommendations (optimal, good, acceptable) for each parameter
- Guidelines for comparing data generated using different methods

Information about what participating (and some non-participating) time-series sites are measuring, what methods they are using, and how to access data and detailed methods documentation when available.

Laura Lorenzoni and Heather Benway

The Global Ocean Data Analysis Product version 2

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, November 12-14, 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's foreseen that it will evolve into a routine effort, with regular releases of updated versions in the future.

Are Olsen

The Global Carbon Budget 2012

[The Global Carbon Budget 2012](#) (for year 2011) was released on 3 December 2012. This annual update of the global carbon budget and trends can be accessed from the Global Carbon Project website. The data sources and files as well as highlights of the results plus outreach materials such as slides, images and videos are all available. Specific topics covered by the budget include: global emissions from fossil fuels and cement, regional fossil fuel emissions, consumption-based fossil fuel emissions, emissions from land-use change, emission

pathways, CO₂ removals by natural sinks and atmospheric CO₂. The [peer-review articles](#), which the Budget is based on, are also available (subscription based access in one case).

The Legacy of *in situ* Iron Enrichment Experiments: Creation of a Relational, Open-Access Database

Thirteen ocean iron enrichments have been conducted over the past two decades. [SCOR Working Group 131](#) 'The Legacy of *in situ* Iron Enrichment: Data Compilation and Modeling' has set out to capture and safeguard the richness of these experiments via the creation of a relational, open-access database at the Biological and Chemical Oceanography Data Management Office (BCO-DMO) at Woods Hole Oceanographic Institution.

The data of nine experiments (IronEx I and II, SOIREE, SOFeX North and South, SERIES, SEEDS I and II and SAGE) are directly available from BCO-DMO (<http://osprey.bco-dmo.org/program.cfm?flag=viewp&id=10&sortby=program>). Data from three further studies (EisenEx, EIFEX and soon LOHAFEX) can be accessed via links to PANGAEA (<http://www.pangaea.de>). Data from FeeP will be archived at the British Oceanographic Data Centre (<http://www.bodc.ac.uk/>).

The data comprise physical, chemical, biological and optical oceanographic measurements. The experimental data provide a valuable resource for understanding and modelling the functioning of the marine food web and

carbon cycling in response to iron addition. Data synthesis might address a variety of topics, for example the ratio of carbon transported to the deep ocean per unit iron added and the role of iron stimulated blooms as a source of climatically active gases. The experimental data provide a unique benchmark for evaluating geo-engineering proposals.

Phil Boyd, Dorothee Bakker, Cynthia Chandler

EPOCA, the first international project on ocean acidification came to an end in 2012

Ocean acidity has increased by 30% in the past 250 years and could increase by at least another 100% by the end of this century. This phenomenon, known as “ocean acidification”, is due to the uptake of 25% of the human-produced CO₂ by the ocean (about 24 millions tons CO₂ every day). While this uptake help to mitigate climate change, ocean acidification threatens marine biodiversity and could affect economically important marine resources, including fish, shellfish and coral reefs.

During the four years between 2008 and 2012, more than 160 European scientists from 32 laboratories came together to collaborate around this research topic. The European Project on Ocean Acidification ([EPOCA](#)), coordinated by the French *Centre National de la Recherche Scientifique (CNRS)*, was launched in May 2008 and brought together participants from Belgium, France, Germany, Iceland, Italy, the Netherlands, Norway, Sweden, Switzerland and the UK. More than [170 papers](#) investigating the consequences of increasing CO₂ emissions

on marine organisms and ecosystems were produced during the life time of the project.

The research carried out through EPOCA was structured into four themes: **Theme 1** investigated the **changes in ocean chemistry and biogeography across space and time**. Paleo-reconstruction methods were used on several archives, including foraminifera and deep-sea corals, to determine the past variability in ocean chemistry (carbonate, nutrients and trace metals) and to tie these to present-day chemical and biological observations; **Theme 2** studied the **sensitivity of marine organisms, communities and ecosystems to ocean acidification**. Key climate-relevant biogeochemical processes such as calcification, primary production and nitrogen fixation were investigated using a large array of techniques, ranging from molecular tools to physiological and ecological approaches. Perturbation experiments were carried out both in the laboratory and in the field, including a major large-scale offshore mesocosm experiment in Svalbard in the summer of 2010; **Theme 3** focused on the **integration of the results** from Themes 1 and 2 in **biogeochemical, sediment, and coupled ocean-climate models** to better understand and project the responses of the Earth system to ocean acidification. Special attention was paid to feedbacks of physiological changes on the carbon, nitrogen, sulfur and iron cycles and how these changes will affect and be affected by future climate change; **Theme 4** synthesized the results from Themes 1-3 and assessed **uncertainties, risks and thresholds ("tipping points") related to ocean acidification** at scales ranging from sub-cellular to ecosystem and local to global scales. A second focus of this theme was to **communicate the findings** to fellow

scientists but also to policy makers, media, schools and the general public.

Activities beyond the core research themes undertaken by the EPOCA scientists included:

Software development

EPOCA scientists have designed and continues to develop the R software package *seacarb* (Gattuso & Lavigne, 2009; Lavigne & Gattuso, 2011). *seacarb* calculates parameters of the carbonate system. It also comprises new functions aimed at assisting the design of ocean acidification perturbation experiments. The [seacarb package](#) can be downloaded from the Comprehensive R Archive Network (CRAN).

Best Practices Guide

EPOCA and IOC-UNESCO led the production of the community reviewed “*Guide to best practices in ocean acidification research and data reporting*”, a collaborative effort of EPOCA and international colleagues to make sure that experiments on ocean acidification are properly and effectively carried out, and to facilitate comparisons of studies. After the launch in May 2010 and after distribution of more than 700 copies, a revised version was printed in 2011. The guide is available free of charge [online](#) and in print. Over 1000 copies have been distributed worldwide.

Ocean acidification blog

EPOCA has maintained an information outlet on ocean acidification with information on scientific articles, job opportunities, projects, press releases and media coverage. Check out the blog [here](#).

EPOCA data management

Two EPOCA databases were maintained. The observational database, hosted at Pangaea, includes data from perturbation experiments as well as data from five cruises, two repeat transects, one time-series station and one site survey. The modeling database is hosted at LSCE and comprises outputs from seven Earth System Models, most of which were used in the IPCC's last assessment report AR4. These models, which account for changes in climate as well as increasing atmospheric CO₂, include IPSL-CM4-LOOP, CSM1.4, CCSM3, BCM-C, COSMOS, and HadCM3LC, and UVIC2.8. Some of the observational data and modelling data archive are publicly available and can be [accessed](#) via the EPOCA website.

Outreach and communication

EPOCA has led an intense effort on communication the findings of the project to a wider public, including policy makers and other stakeholders, schools and the general public. Key outreach products include the guides produced by the Reference User Group (quality-controlled by EPOCA scientists to ensure scientific accuracy) and a “Frequently Asked Questions” document, all produced in several languages and widely distributed. These and other products can also be [downloaded](#) from the EPOCA website.

EPOCA contributed to advancing the state of knowledge on ocean acidification and its impact on marine organisms and ecosystems. It produced 21% of the research papers on ocean acidification published during the period 2009-2012, and leaves behind key products that should prove useful to the research community and policymakers.

Research on ocean acidification will continue through several national and regional projects, however the [SOLAS-IMBER Working Group on Ocean Acidification](#) and the [International Ocean Acidification Reference User Group](#) have identified the need to coordinate ocean acidification research at the international level. They have prepared and submitted a proposal to launch an Ocean Acidification International Coordination Center which, when funded, will allow for truly global coordination of ocean acidification research and observations.

Jean-Pierre Gattuso and Lina Hansson

Changes in the IOCCP Project Office

We had two major changes in the IOCCP office last year: an unexpected relocation of the Project Office and 50% staff reduction. Luckily, the new IOCCP hosts proved to be extremely helpful and supportive and we are not far from securing relevant funds to hire the “missing” staff. Below you can read a brief explanation of how it all happened.

Project Office relocation

The IOCCP staff salary support has been provided by the US National Science Foundation (NSF) since the formation of the project. Salary support for Project Director and Deputy Director was most recently provided by a 3-year grant from US NSF to the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) that began in January 2011. Due to the vote of the UNESCO General Conference to admit Palestine as a Member State (31 October 2011), the US was required by federal law to withdraw all

direct and voluntary contributions to UNESCO. As a result, NSF funding for IOCCP staff support was cut off on 2 November 2011. IOC-UNESCO was able to identify emergency funding from the Global Ocean Observing System to continue the staff positions through 31 March 2012.

Following extended negotiations between all the involved organizations, the IOCCP Project Office moved its headquarters at the IOC-UNESCO in Paris on 1 April 2012. Initially the IOCCP Office was jointly hosted by the Institute of Oceanology of the Polish Academy of Sciences (IO PAN) in Sopot, Poland and the Joint Office for Science Support of the University Corporation for Atmospheric Research (UCAR/JOSS) in the United States. Beginning 1 October 2012, IO PAN in Sopot, Poland became the permanent home of IOCCP Project Office.

The Scientific Committee on Oceanic Research (SCOR) and the IOC-UNESCO continue to co-sponsor IOCCP activities and NSF continues providing Project Office staff support.

Office Staff

After three and a half years of service, on September 30 2012, Dr Kathy Tedesco stepped down as the Director of the IOCCP. Having Kathy in charge of the IOCCP Project Office has been a privilege. As a former research scientist, and with significant program management experience, Kathy had no difficulties to meet the goals of the IOCCP. This has never been an easy task, particularly during the turbulent time in 2012 that included the relocation of the Project Office to Poland. Kathy was successful in prioritizing a diverse workload, managing budgets, organizing workshops

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and working with scientists to produce necessary planning documents and reports. She always had the right perspective to understand the obligations and demands of scientists who are asked to contribute to IOCCP activities often with no additional funding. We would like to take this opportunity to once more thank Kathy for all the work she has done for IOCCP and to congratulate her for her new position outside the IOCCP.

At the same time Dr Maciej Telszewski has been appointed the new Project Director effective 1 October 2012. Maciej is well known to most of you, as he has served as the IOCCP Deputy Director since January 2011, during which time he has been increasingly involved in coordinating the numerous IOCCP activities.

The IOCCP Conveyor is edited by Maciej Telszewski (m.telszewski@ioccp.org)
