

## **THE INTERNATIONAL OCEAN CARBON COORDINATION PROJECT (IOCCP)**

*A joint project of SCOR and IOC and an affiliate program of the Global Carbon Project.*

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UNESCO

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### **The Ocean in a High CO<sub>2</sub> World-II Meeting Summary and Follow-up**

The first Ocean in a High CO<sub>2</sub> World Symposium, held four years ago at UNESCO headquarters in Paris, brought together 120 scientists from 18 countries to discuss how increases in atmospheric CO<sub>2</sub> were affecting ocean chemistry and biology, to evaluate potential strategies to artificially enhance ocean carbon uptake, and to discuss directions for future research. The term ocean acidification was not in wide use, and only a small group of specialists had been studying how increasing marine concentrations of CO<sub>2</sub> and corresponding reductions in pH and carbonate ion concentrations were affecting marine organisms, mostly corals. At that time, ocean scientists were primarily studying the beneficial effects of the ocean's great capacity to take up CO<sub>2</sub>, thereby moderating the increase in atmospheric CO<sub>2</sub> from fossil-fuel burning. But as the meeting progressed, there was a growing awareness of many problems associated with corresponding changes in ocean chemistry and associated biological impacts.

The first symposium marked a turning point for many scientists, who suddenly understood that the impacts of ocean uptake of CO<sub>2</sub> were as important as its benefits. The media also picked up on these growing concerns and interest increased rapidly as national ocean acidification reviews were released and several papers from the symposium were published in high-profile science journals.

Four years later, under heightened concern, the scientific community was reunited for a second Ocean in a High CO<sub>2</sub> World symposium. The 2<sup>nd</sup> symposium was held on 6-9 October 2008 at the Oceanography Museum of Monaco under the High Patronage of His Serene Highness Prince Albert II. The symposium was sponsored by SCOR, IOC-UNESCO, the International Atomic Energy Agency's Marine Environmental Laboratory and the International Geosphere-Biosphere Program, and supported by the Prince Albert II Foundation, the Centre Scientifique de Monaco, the US National Science Foundation, the International Council for the Exploration of the Sea, and the North Pacific Marine Science Organization.

The meeting brought together 250 scientists from 32 countries to assess what is known about ocean acidification impacts on marine chemistry and ecosystems. The symposium included invited and contributed talks, posters, and discussion sessions to address 3 key areas: 1) Natural and artificial perturbation experiments to assess acidification; 2) Observation networks for tracking acidification and its impacts; and 3) Scaling organism-to-ecosystem acidification effects and feedbacks on climate.

Highlights included new projections of aragonite undersaturation in the Arctic as early as 2018, the impacts of acidification on trace metal cycling, detectable changes in the shell weight of foraminifera and pteropods in the field, innovative perturbation experiments on invertebrate reproduction and larval stages, and impacts of pCO<sub>2</sub> and temperature on larval stages of oysters demonstrating that selective breeding may reduce vulnerability to acidification impacts.

To highlight some of the significant results from the symposium, a subset of results will be published in a special issue of the journal *Biogeosciences*. A Research Priorities Report is in final review to summarize and highlight the meeting results and recommendations. A summary for policymakers and conference declaration will also be published. The symposium web-site will soon be updated to include invited speakers' presentations.

**For more information:** visit the Ocean in a High CO<sub>2</sub> World web-site on the Ocean-Acidification Network ([www.ocean-acidification.net](http://www.ocean-acidification.net) > The Ocean in a High CO<sub>2</sub> World) or direct link to <http://ioc3.unesco.org/oanet/HighCO2World.html>

### **Report of the 3<sup>rd</sup> Session of the IOCCP Scientific Steering Group**

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.

The IOCCP held its 3<sup>rd</sup> Scientific Steering Group meeting from 3-4 October at the Oceanographic Laboratory of Villefranche-sur-mer, France. This was the first meeting the new 2008-2010 SSG. Continuing Chair Chris Sabine (NOAA/PMEL, USA) was joined by returning members Masao Fukasawa (JAMSTEC, Japan) and Dorothee Bakker (UEA, UK), and new members including Toste Tanhua (IfM-Geomar, Germany), Alex Kozyr (CDIAC, USA), Ute Schuster (UEA, UK), Melchor Gonzalez (U. Las Palmas de Gran Canaria, Spain), Pedro Monteiro (CSIR, South Africa), and Yukihiro Nojiri (NIES, Japan).

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

Major activities for the next year include continuation of the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) and the Surface Ocean CO<sub>2</sub> Atlas Project (SOCAT), and a new emphasis on coordination of carbon and biogeochemical time series stations

in collaboration with the OceanSITES project. There are also several actions aimed at augmenting the surface pCO<sub>2</sub> VOS network and assisting the scientific community in dealing with commercial shipping companies.

***For more information:*** Download the report of the SSG-3 ([http://ioc3.unesco.org/ioccp/Docs/IOCCP\\_SSG3\\_Final.pdf](http://ioc3.unesco.org/ioccp/Docs/IOCCP_SSG3_Final.pdf)) or visit the IOCCP web-site ([www.ioccp.org](http://www.ioccp.org)).

## **Changing Times: Summary of the International Time Series Meeting**

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

In 1999, an international group of scientists formed the OceanSITES program to develop a coordinated, interdisciplinary international network of stations, research programs, and scientists to sustain and enhance the use of time-series observations. Although the physical oceanographic community is strongly tied into OceanSITES, the biogeochemical community still lacks coordination. To support and strengthen the ocean carbon and biogeochemical time-series effort, the IOCCP, OceanSITES, POGO, and the U.S. OCB program sponsored a workshop to mobilize the community to participate in this international network and to highlight the critical research that can only be carried out using time-series (both ship-board and autonomous) observations.

The workshop brought together 40 participants from 17 countries to review the scientific rationale for sustained time series observations of carbon and biogeochemistry; the value of networking observations; existing global, regional, and national programmes; needs, interests and emerging issues; technology and development issues; and collaboration and networking needs, interests and possibilities.

The workshop consisted of plenary talks, brief presentations of time series stations from all 17 countries, and break-out groups to compile basin-scale observing system information, to identify the major science drivers and development priorities for the next 5-10 years, and to identify regional needs and opportunities for networking and coordination.

While many of the carbon and biogeochemistry time-series stations were appropriate for coordination within the OceanSITES framework (e.g., open-ocean, Eulerian, and open data policy), other stations and biogeochemical observation programs were not. The workshop participants agreed to work in collaboration with OceanSITES were appropriate, but also to develop an inventory of all carbon and biogeochemistry observing programs to facilitate coordination and communication amongst them. This inventory would be restricted to observation programs that are meant to be long-term, and would not include process studies or one-off experiments.

**For more information:** Visit the IOCCP web-site and download the report (in preparation) ([www.ioccp.org](http://www.ioccp.org)).

## **Ocean Acidification Best Practices Meeting Update**

The European Project on Ocean Acidification, the IOCCP, the US Ocean Carbon and Biogeochemistry Program, and the Kiel Excellence Cluster the “Future Ocean” are co-sponsoring a workshop to develop a guide of best practices and data reporting for ocean acidification research. The workshop will be held from 19-21 November at the Leibniz Institute of Marine Sciences (IFM-GEOMAR) in Kiel, and will bring together approximately 40 scientists from the EU, US, Japan, Korea, China and Australia. Sessions will include carbonate chemistry, experimental design of perturbation experiments, measurements of CO<sub>2</sub>-sensitive processes, and data reporting and usage. Break-out and writing groups will focus on 3 major issues: Carbonate system measurements, manipulations and experimental CO<sub>2</sub> / Ω levels; Measurement of calcification processes, data normalization, reporting and archiving; and Measurement of CO<sub>2</sub>-sensitive processes (other than calcification), data normalization, reporting and archiving.

The workshop will produce several short technical reports on perturbation and calcification experiments, as well as a Guide to Best Practices for Ocean Acidification Research and Data Reporting. It is anticipated that the draft guide will be made available on-line for an open 3 month community review period before publication. After publication of the Guide, the IOCCP will investigate the interest and feasibility of a review and training workshop to present the best practices and data reporting procedures to the wider community, with a special emphasis on students and scientists new to ocean acidification research.

**For more information:** visit the EPOCA web-site at: <http://epoca-project.eu/> or contact Maria Hood at [m.hood@unesco.org](mailto:m.hood@unesco.org).

## **SCOR General Meeting Approves Carbon Working Groups**

The 2008 SCOR General Meeting was held at the Woods Hole Oceanographic Institution in Woods Hole Massachusetts from 22-24 October, where the SCOR representatives reviewed proposals for new working groups. Two carbon-related working groups were approved:

The Microbial Carbon Pump in the Ocean Working Group will document the state of the art in microbial processing of organic carbon and acquire new insights through analyzing the available data on microbial biomass, production and diversity along with dissolved organic matter (DOM) data from a variety of marine environments. The goal of the Working Group is to identify priority scientific questions and the corresponding technical needs, and establish or standardize protocols for the observations of key microbial and DOM parameters, to advance interdisciplinary research on the microbial carbon pump in the ocean. This group is co-chaired by Nianzhi Jiao (China) and Farooq Azam (USA).

The Working Group on Hydrothermal Energy Transfer and its Impacts on the Ocean Carbon Cycles will investigate the diverse pathways of biomass generation driven by hydrothermal processes and the potential contribution that they make to the global ocean carbon cycle. The objective of the Working Group is to bring together an interdisciplinary group of marine scientists with three key goals: to synthesize current knowledge of chemical substrates, mechanisms and rates of chemosynthetic carbon fixation at hydrothermal systems as well as the

transfer of phytoplankton-limiting micronutrients from these systems to the open ocean; to integrate these findings into conceptual models of energy transfer and carbon cycling through hydrothermal systems which would lead to quantification of primary production in view of a future assessment of the contribution of these systems to the global-ocean carbon cycle; and to identify critical gaps in current knowledge and proposing a strategy for future field, laboratory, experimental and/or theoretical studies to bridge these gaps and better constrain the impact of deep-sea hydrothermal systems on ocean carbon cycles. The Working Group is co-chaired by Nadine Le Bris (France) and Christopher German (USA).

**For more information:** Download the Working Group proposals at <http://www.scor-int.org/2008GM/2008GM.htm>.

## Carbon at OceanObs09

Almost a decade has passed since the OceanObs'99 symposium played a major role in consolidating the plans for a comprehensive ocean observing system, able to deliver systematic global information about the physical environment of the oceans. For the first time in history, the world's oceans are being observed routinely and systematically by means of satellite and in situ techniques.

It is now critically important to establish an international framework that will sustain the present system, evolve it to respond to increasing needs, and help it realize the full extent of its benefits across all stakeholders. It is equally important to present a clear vision extending the present observing system to include comprehensive and routine observations, information and services on the biogeochemical state of the ocean and the status of marine ecosystems.

The World Climate Research Programme (WCRP), the Global Ocean Observing System (GOOS), and the Global Climate Observing System (GCOS) have called for the OceanObs'09 conference, charging the organizers to address the issues raised above and to help lay out a path for sustaining the benefits of ocean information and services in the coming decade.

OceanObs09 will be held in Venice, Italy, 21 to 25 September 2009 ([www.oceanobs09.net](http://www.oceanobs09.net)). The conveners of this conference ask for your participation in shaping the meeting and to build the community consensus we hope to achieve through preparations for the conference.

The IOCCP will provide coordination support for 3 contributed white papers to the conference:

1. Repeat Hydrography – the IOCCP-CLIVAR Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) has developed a white paper outlining a strategy for interdisciplinary repeat hydrography. This strategy will be circulated widely for input and comments prior to submission as a community white paper to the conference.
2. Time Series – the IOCCP will work with the OceanSITES program to develop a white paper on interdisciplinary time series stations, and perhaps a 2<sup>nd</sup> paper on integrating carbon and biogeochemistry observations.
3. Carbon VOS network – the IOCCP scientific steering group has proposed the development of a community white paper outlining a strategy for carbon measurements on commercial Volunteer Observing Ships. Interested participants should contact IOCCP director Maria Hood ([m.hood@unesco.org](mailto:m.hood@unesco.org)).

Short proposals are due by 15 November, with the first drafts of the Community White Papers due in March 2009.

**For more information:** Visit the OceanObs09 conference web-site ([www.oceanobs09.net](http://www.oceanobs09.net)). Information about GO-SHIP is available on the IOCCP web-site at: <http://ioc3.unesco.org/ioccp/Hydrography/GOSHIP.html>.

## **London Convention adopts Resolution on Ocean Fertilization**

*From the International Maritime Organization ([www.imo.org](http://www.imo.org))*

Ocean fertilization activities, other than legitimate scientific research, should not be allowed, according to a resolution adopted by Parties to the international treaties which regulate the dumping of wastes and other matter at sea.

"Given the present state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed," says the (non-binding) resolution, adopted by the Contracting Parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention) and to the 1996 Protocol thereto (London Protocol), which met in London from 27 to 31 October 2008 (LC30/LP3).

The resolution followed previous discussions by Parties to the two treaties on planned operations for large-scale fertilization of the oceans using micro-nutrients - for example, iron - to sequester carbon dioxide (CO<sub>2</sub>). The resolution states that ocean fertilization activities other than legitimate scientific research, "should be considered as contrary to the aims of the Convention and Protocol and not currently qualify for any exemption from the definition of dumping".

In the resolution, Parties agreed that scientific research proposals should be assessed on a case-by-case basis using an assessment framework to be developed by the Scientific Groups under the London Convention and Protocol. Until specific guidance is available, Parties should be urged to use utmost caution and the best available guidance to evaluate scientific research proposals to ensure protection of the marine environment consistent with the Convention and Protocol. Parties agreed to consider further a potential legally binding resolution or amendment to the London Protocol at their next session in 2009.

**For more information:** Visit the IMO web-site ([www.imo.org](http://www.imo.org)); visit the Ocean Acidification Network Resource Library for recent related documents ([www.ocean-acidification.net](http://www.ocean-acidification.net) >Resource Library).