

## **U.S. Ocean Carbon and Biogeochemistry (OCB) 2006 Summer Workshop**

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The recently formed U.S. Ocean Carbon and Biogeochemistry (OCB) program held its inaugural science workshop in July, 2006 in Woods Hole, MA, USA. The scientific focus of the OCB is ocean biogeochemistry, especially on the ocean's role as a component of the global Earth system. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by NASA, NOAA, and NSF.

The objectives of the OCB summer 2006 workshop were to highlight recent scientific findings in ocean biogeochemistry and related ecological and physical research, foster improved communication among existing ocean biogeochemistry observing programs and process studies, and discuss applications of emerging observational technologies in marine biogeochemistry. About 80 U.S. and international scientists participated in the four-day meeting, which was supported by the U.S. National Science Foundation (NSF). Electronic versions of the full agenda, poster abstracts, and many of the plenary talks and discussion sessions are available through the workshop web page (<http://ocb.whoi.edu/workshops.html>).

The meeting was organized around several major science themes:

- atmosphere-ocean CO<sub>2</sub> exchange;
- marine ecosystem-biogeochemical dynamics;
- ocean carbon cycle and climate.

In each theme, a series of plenary talks was given synthesizing both field-based and modeling results and in particular emphasizing new findings and unresolved science issues. Here we present a selection of some of the more noteworthy material:

- New independent estimates of Southern Ocean air-sea CO<sub>2</sub> fluxes based on an expanded synthesis of surface pCO<sub>2</sub> data and numerical inversions of ocean carbon interior data show relatively small mean net uptake, much lower than previous observational and model calculations;
- Model simulations suggest substantial interannual variability in Southern Ocean air-sea CO<sub>2</sub> fluxes associated with the Southern Annular Mode, highlighting the need for more high latitude ocean biogeochemical observations and time-series;
- Better instrumentation (e.g., Lagrangian floating sediment traps) and focused process studies are beginning to shed light on biogeochemical transport and remineralization in the mesopelagic region just below the base of the euphotic zone. Organic matter remineralization length scales appear to differ considerably from a subtropical and subpolar site, perhaps linked to temperature;
- Innovative stochastic modeling approaches are being developed to explore competitive exclusion and phytoplankton niches in 3-D models. These techniques

- offer an objective approach for assessing the required complexity of ecological/geochemical functional group models;
- Physical observational and numerical studies illustrate the significant variability on horizontal distances smaller than those associated with mesoscale eddies (~100-300 km). The effect of the resulting large submesoscale vertical velocity variations and lateral stirring on large-scale nutrient fluxes and biological rates and patterns need to be better characterized;
  - Detection and attribution of the long-term temporal trends in ocean biogeochemistry associated with anthropogenic carbon uptake and climate change are substantially hampered by sub-annual to interannual variability. Studies are underway to assess the skill of various numerical, modeling and remote sensing techniques to address these problems;
  - Dramatic and rapid advances are occurring in marine microbial genomics. For example, new findings suggest a much greater prokaryotic and eukaryotic diversity than previously thought. New conceptual models and methods are needed to bridge between the emerging wealth of genomic data and more traditional ecological and biogeochemical approaches;
  - Exciting new capabilities were demonstrated using *in situ* chemical and biooptical sensors on autonomous platforms (profiling floats, moorings, and gliders). These observing technologies will be central to addressing biogeochemical science questions in the upcoming U.S. NSF-funded ORION initiative;
  - A synthesis of paleoceanographic data was presented in support of a new conceptual model to explain the 80-100 ppm drawdown in atmospheric CO<sub>2</sub> from interglacial to glacial periods. The hypothesis involves a long intermediate glacial period where atmospheric CO<sub>2</sub> was only about 40 ppm lower than pre-industrial levels caused by changes in ocean physics and temperature and a full glacial state driven by changes in the ocean alkalinity inventory;
  - A new interpretation was presented to explain the diurnal variations in *in situ* variable fluorescence data from pump/probe instruments. This may provide useful measures of nitrogen and iron stress on phytoplankton physiology and has important implications for traditional ocean color remote sensing;

Special discussion sessions were also held on future research opportunities related to:

- ocean acidification (see also a new report *Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers Report: A Guide for Future Research*; <http://www.isse.ucar.edu/florida/>);
- the Southern Ocean Gas Exchange Experiment (Gas-Ex III; [http://duck-rabbit.ldeo.columbia.edu/so\\_gasex/](http://duck-rabbit.ldeo.columbia.edu/so_gasex/));
- other Southern Ocean physical and biogeochemical field campaigns (DIMES, ACE/CSIRO)
- the EU CARBOOCEAN project (<http://www.carboocean.org>)
- the Hawaii Ocean Time-Series (HOT; <http://hahana.soest.hawaii.edu/hot/hot.html>);
- and the Ocean Research Interactive Observatory Networks (ORION; [www.orionprogram.org](http://www.orionprogram.org)).

Another Ocean Carbon and Biogeochemistry science workshop will be held in the summer of 2007, the exact dates and location to be announced via email and on the OCB website (<http://ocb.whoi.edu>).