

OCB Ocean Acidification Short Course : Course Materials

Video Footage of Course Lectures

Click on the right for accompanying lectures (in pdf format) and other reference material from the course. The video files are being processed and will be posted as they become available.

MONDAY NOVEMBER 2

- [Overview of the ocean CO₂ system](#) (Sabine)
- [Introduction to CO₂ chemistry in seawater media, analytical parameters, and current measurement techniques](#) (Dickson)
- [Introduction to CO2SYS](#) (Sabine)
- [Introduction to seacarb](#) (Gattuso)
- [CO₂ water sampling movie](#) (Dickson)
- [Introduction to underway pCO₂ system](#) (Wang)

TUESDAY NOVEMBER 3

- [pH and Alkalinity](#) (Dickson)
- [Overview of biogeochemical feedbacks](#) (Hutchins)

WEDNESDAY NOVEMBER 4

- [Quality control of analytical measurements of CO₂ parameters](#) (Dickson)
- [Advantages and disadvantages of current analytical approaches? How well can you control the CO₂ system in your experiment?](#) (Wang)
- [Implications of uncertainties in equilibrium constants and analytical measurements](#) (Dickson)
- [Choosing the optimal parameters for a particular ocean acidification experiment and learning how well you need to measure the parameters you choose](#) (Sabine)
- [Overview on experimental design](#) (Langdon)

THURSDAY NOVEMBER 5

- [Approaches and tools to manipulate carbonate chemistry](#) (Gattuso)
- [Moored CO₂ instrument demonstration](#) (Sabine)

FRIDAY NOVEMBER 6

- [Algal culturing overview](#) (Iglesias-Rodriguez)
- [Calcification in a high-CO₂ world](#) (Cohen)
- [Measuring calcification in biological experiments - Mollusks](#) (Miller)

SATURDAY NOVEMBER 7

- [Radioisotope techniques for measuring coccolithophore calcification](#) (Balch)
- [PIC methods for quantifying calcification](#) (Iglesias-Rodriguez)
- [Measuring calcification in the field](#) (Langdon)

MONDAY NOVEMBER 9

- [Ocean Data View](#) (Schlitzer)

Related Files

- » [UNABRIDGED COURSE SYLLABUS \(505 PAGES, 17-18 MB\)](#)
- » [At-A-Glance Course Schedule](#)
- » [Detailed Course Schedule](#)
- » [OA Short Course Participant Learning Outcomes](#)
- » [Chris Sabine: Overview of the Ocean CO₂ System](#)
- » [Andrew Dickson: Introduction to CO₂ Chemistry in Seawater Media](#)
- » [Aleck Wang: Introduction to Underway pCO₂ System](#)
- » [Short reference card for R](#)
- » [seacarb training](#)
- » [seacarb test data](#)
- » [Andrew Dickson: pH and Alkalinity](#)
- » [Dave Hutchins: Overview of Biogeochemical Feedbacks](#)
- » [IRGA DIC Results](#)
- » [Coulometric DIC movie](#)
- » [Andrew Dickson: Quality Control of Analytical Measurements of CO₂ Parameters](#)
- » [Andrew Dickson: Implications of Uncertainties in Equilibrium Constants and Analytical Measurements](#)
- » [Chris Sabine: Choosing the Optimal Parameters for a Particular Ocean Acidification Experiment and Learning How Well You Need to Measure the Parameters You Choose](#)
- » [Chris Langdon: Overview of Experimental Design](#)
- » [Jeanne-Pierre Gattuso: Approaches, Tools to Manipulate Carbonate Chemistry](#)
- » [Shi et al. \(2009\)](#)
Shi, D., Xu, Y., and Morel, F. M. M. (2009). Effects of the pH/pCO₂ control method on medium chemistry and phytoplankton growth, Biogeosciences 6: 1199-1207.
- » [Kim Yates: Hands-on CO2SYS exercise](#)
- » [Sabine/Dickson: Summary of discussion on optimal CO₂ parameters](#)
- » [Debora Iglesias-Rodriguez: Algal Culturing Overview](#)
- » [de Beer et al. \(2000\)](#)
de Beer D., Kühl M., Stambler N., Vaki L. (2000) A microsensor study of light enhanced Ca²⁺ uptake and photosynthesis in the reef-building hermatypic coral *Favia* sp. Marine Ecology Progress Series 194, 75–85.
- » [Al-Horani et al. \(2003\)](#)
Al-Horani, F.A., Al-Moghrabi, S.M., de Beer, D. (2003). The mechanism of calcification and its relation to photosynthesis and respiration in the

TUESDAY NOVEMBER 10

- [Biogeochemical modeling](#) (Doney)
- [Physiology](#) (Seibel)

WEDNESDAY NOVEMBER 11

- [Large-scale data products for open ocean biogeochemistry - Part 1](#) (Doney/Key)
- [Large-scale data products for open ocean biogeochemistry - Part 2](#) (Doney/Key)
- [Genomics applications to ocean acidification research - Part 1](#) (Fangue)
- [Genomics applications to ocean acidification research - Part 2](#) (Fangue)

THURSDAY NOVEMBER 12

- [Introduction to Data Management and Better Practices for Shipboard Data Management](#) (Chandler)
- [Biogeochemical Modeling Part II](#) (Doney)
- [Experimental synthesis and discussion](#) (Langdon)

FRIDAY NOVEMBER 13

- [CDIAC and Data Reporting](#) (Kozyr)

Information on CO₂ Instrumentation

[International Ocean Carbon Coordination Project \(IOCCP\) website](#) (click on Sensors in lefthand menu) - includes instrumentation information for measuring dissolved inorganic carbon (DIC), pH, total alkalinity, pCO₂, and particulate carbon

REQUIRED SOFTWARE CO₂SYN (Sabine)

[CO₂SYN_calc_XLS](#): Pierrot, D. E. Lewis, and D. W. R. Wallace. 2006. MS Excel Program Developed for CO₂ System Calculations. ORNL/CDIAC-105a. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee.

SEACARB (Gattuso)

The software package *seacarb* will be used during the course. All participants are invited to download and install, before the course starts, the following software on their laptop:

- 1) The version of the R program suitable with the OS installed on your laptop. Versions for Mac OSX, linux, unix and Windows are available [here](#).
- 2) The R package *seacarb*. To do that, launch R, go to "Packages & Data: Packages installer", click on "Get list", look for *seacarb* and click "Install selected".
- 3) [seacarb manual](#)

BIOGEOCHEMICAL MODELING

[MIT/WHOI Modeling Course](#) (Doney)

[Carbon Dioxide Information Analysis Center \(CDIAC\)](#) (Key)

What We Know About Climate Change (Boston Review Books) by Kerry Emanuel, Judith

scleractinian coral *Galaxea fascicularis*. Marine Biology 142: 419-426.

» [Al-Horani et al. \(2007\)](#)

Al-Horani, F.A., Tambutté, É., Allemand, D. (2007). Dark calcification and the daily rhythm of calcification in the scleractinian coral, *Galaxea fascicularis*. Coral Reefs 26: 531–538.

» [de Nooijer et al. \(2009\)](#)

de Nooijer L.J., Takashi Toyofuku T., Kitazato H. (2009). Foraminifera promote calcification by elevating their intracellular pH. PNAS 106: www.pnas.org/cgi/doi/10.1073/pnas.0904306106.

» [Whitman Miller: Measuring Calcification in Biological Experiments - Mollusks](#)

» [William Balch: Radioisotope Techniques for measuring coccolithophore calcification](#)

» [Debora Iglesias-Rodriguez: DIR-PIC measurements for estimating calcification](#)

» [Andersson et al. \(2008\)](#)

Andersson, A.J., Mackenzie, F.T., Bates, N.T. (2008). Life on the margin: implications of ocean acidification on Mg-calcite, high latitude and cold-water marine calcifiers. Marine Ecology Progress Series 373: 265-273.

» [Morse et al. \(2006\)](#)

Morse, J.W., Andersson, A.J., Mackenzie, F.T. (2006). Initial responses of carbonate-rich shelf sediments to rising atmospheric pCO₂ and

"ocean acidification": Role of high Mg-calcites. Geochimica et Cosmochimica Acta 70: 5814-5830.

» [Chris Langdon: Measuring calcification in the field](#)

» [Reiner Schlitzer: Ocean Data View](#)

» [Scott Doney: Biogeochemical Modelling Introduction](#)

» [Brad Seibel: Physiology](#)

» [Seibel et al. \(In Press\) critique of Brewer & Peltzer respiration index](#)

» [Bob Key \(given by S. Doney\): Large Data Sets](#)

» [Data from coral calcification experiment](#)

» [Data from larval mollusk experiment](#)

» [Cyndy Chandler: Introduction to Data Management](#)

» [Cyndy Chandler: Shipboard Practices for Data Management](#)

» [Anne-Marin Nisumaa: Data rescue presentation](#)

» [Scott Doney: Biogeochemical Modeling Part II](#)

» [Michael Holcomb: Experimental Wrap-up](#)

» [Chris Langdon: Experimental Wrap-up](#)

» [Chris DuFore: Spectrophotometric TA spreadsheet](#)

» [Chris DuFore: Spectrophotometric pH spreadsheet](#)

» [Alex Kozyr: Data Reporting](#)

» [Group Photo: By Mark Carls](#)

» [Schuster et al. \(2009\) dissolved carbon](#)

A. Layzer, and William R. Moomaw (Hardcover - Sep 30, 2007), The MIT Press, 96 pp.,
Language: English, ISBN-10: 0262050897, ISBN-13: 978-0262050890.

Easterling, D. R., and M. F. Wehner (2009), Is the climate warming or cooling?,
Geophys. Res. Lett., 36, L08706,
<http://www.agu.org/journals/gll/gll0908/2009GL037810/doi:10.1029/2009GL037810>.

November 11 Biogeochemical Modeling Demonstration (Doney): Matlab Scripts
(download matlab files to the right)

[instrumentation paper](#)

» [euler_demo.m](#)

» [dicbio.m](#)

» [equic.m](#)

» [pco2_dicalk.m](#)

» [dicbio_main.m](#)

» [OA course TA and pCO₂ equilibrators comparisons](#)

OCEAN DATA VIEW (Schlitzer)

[Download ODV 4.2.0](#). Choose the version for your computer (Windows, Mac OS X or Linux) and follow the installation instructions. People need to register to get access.

[Download the CARINA data](#) and follow installation instructions.

[Download the GLODAP data](#) and follow installation instructions.

Participants new to ODV are strongly encouraged to try running ODV on the CARINA and GLODAP datasets before they come to the course. The [getting started document](#) and the [ODV User's Guide](#) should help you get acquainted with the software. Context-sensitive help is available from inside ODV. Participants are also strongly encouraged to bring their own data. Practicing the import of new data into ODV will be part of the course.

Related Links

» [Guide for Best Practices on Ocean Acidification Research and Data Reporting](#)

DATA MANAGEMENT AND REPORTING (Chandler/Kozyr)

Important Data Management Links (Chandler)

- [NSF Division of Ocean Sciences Data and Sample Policy](#). National Science Foundation. NSF 04-004
- [Biological and Chemical Oceanography Data Management Office \(BCO-DMO\) Home Page](#)
- [BCO-DMO Data Management Guidelines Manual](#) (available from the [BCO-DMO Resources page](#))
- Anne-Marin Nisumaa (Villefranche-sur-mer, France) - Data rescue presentation: "EPOCA/EUR-OCEANS data rescue and transformation on ocean acidification" - download pdf (see list of files to the right)

Important Data Reporting Links (Kozyr)

CDIAC Global Ocean CO₂ Database Components

- [WOCE Database](#)
- [GLODAP Database](#)
- [CLIVAR Repeat Hydrography and Carbon Database](#)
- [VOS Underway pCO₂ Database](#)
- [Moorings and Time Series Database](#)
- [Global Coastal Program Data](#)
- [CARINA Database](#)
- [Global Surface Ocean Alkalinity Climatology Database \(K. Lee\)](#)
- [LDEO \(Takahashi\) Global Surface pCO₂ Database](#)

IMPORTANT BACKGROUND MATERIALS: SEGMENTS 1 & 2

Riebesell, U., Fabry, V. J., Gattuso, J-P (Eds.) (In Preparation). [Guide to Best Practices in Ocean Acidification Research and Data Reporting](#).

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. [Guide to best practices for ocean CO₂ measurements](#). PICES Special Publication 3, 191 pp.

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Mail: Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543, USA.

E-Contact: info@whoi.edu; press relations: media@whoi.edu, tel. (508) 457-2000

Problems or questions about the site, please contact webdev@whoi.edu