



Putting workshop reports to use:

Workshop Recommendations:

IMPACTS OF OCEAN ACIDIFICATION ON CORAL REEFS AND OTHER MARINE CALCIFIERS

A GUIDE TO FUTURE RESEARCH



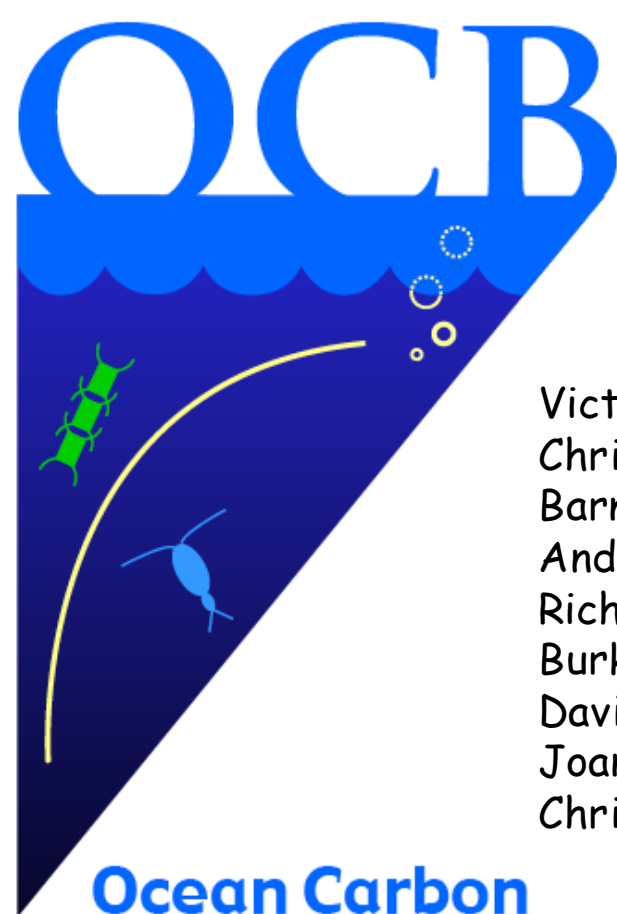
REPORT OF A WORKSHOP SPONSORED BY

NSF NOAA USGS

JA KLEYPAS . RA FEELY . VJ FABRY
C LANGDON . CL SABINE . LL ROBBINS



- Biological research needs
 - Cross-taxa responses
 - Synergistic effects (Ω , T, light, nuts)
 - Long-term monitoring of community-scale response
 - Base-line surveys of calcification rates in the field
 - Biocalcification mechanisms
- Improved oceanic monitoring capability to establish base-lines and track rate and variability
 - Enhanced technologies
 - Observing platforms
 - Long-term time-series hydrographic stations (e.g. BATS, HOTS)
 - Satellite tool development (scale up ship and platform obs, PIC determination)
- Better characterization of carbonate chemistry in coastal systems
 - Base-line characterizations
 - Diurnal, seasonal, decadal variability
 - Much improved carbonate budgets
 - Community Feedback



Scoping Workshop on Ocean Acidification Research

**EUROPEAN
SCIENCE
FOUNDATION**
SETTING SCIENCE AGENDAS FOR EUROPE

Workshop Steering Committee:

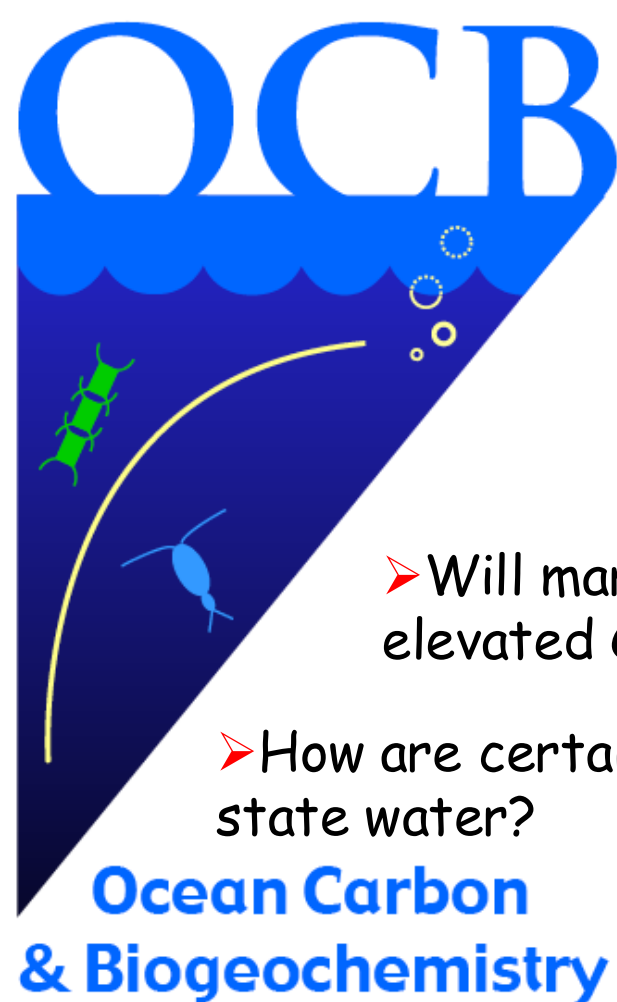
Victoria Fabry, California State University San Marcos (chair)
Chris Langdon, University of Miami (chair)
Barney Balch, Bigelow Laboratory for Ocean Sciences
Andrew Dickson, Scripps Institution of Oceanography
Richard Feely, NOAA/ Pacific Marine Environmental Laboratory
Burke Hales, Oregon State University
David Hutchins, University of Southern California
Joan Kleypas, National Center for Atmospheric Research
Chris Sabine, NOAA/ Pacific Marine Environmental Laboratory

**Ocean Carbon
& Biogeochemistry**

9-11 October 2007

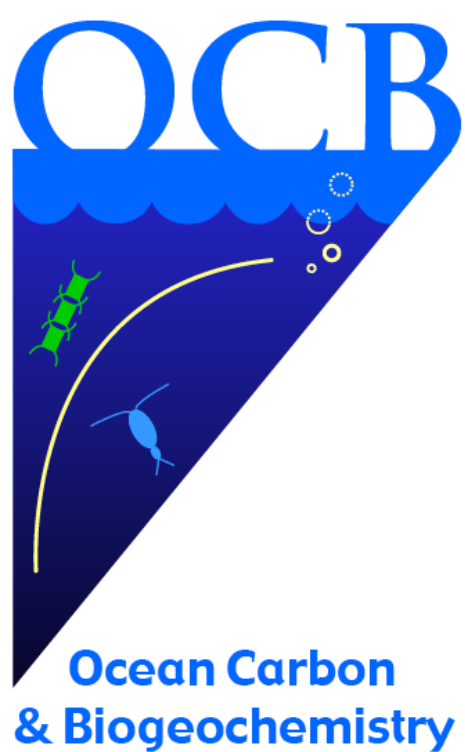
Scripps Institution of Oceanography





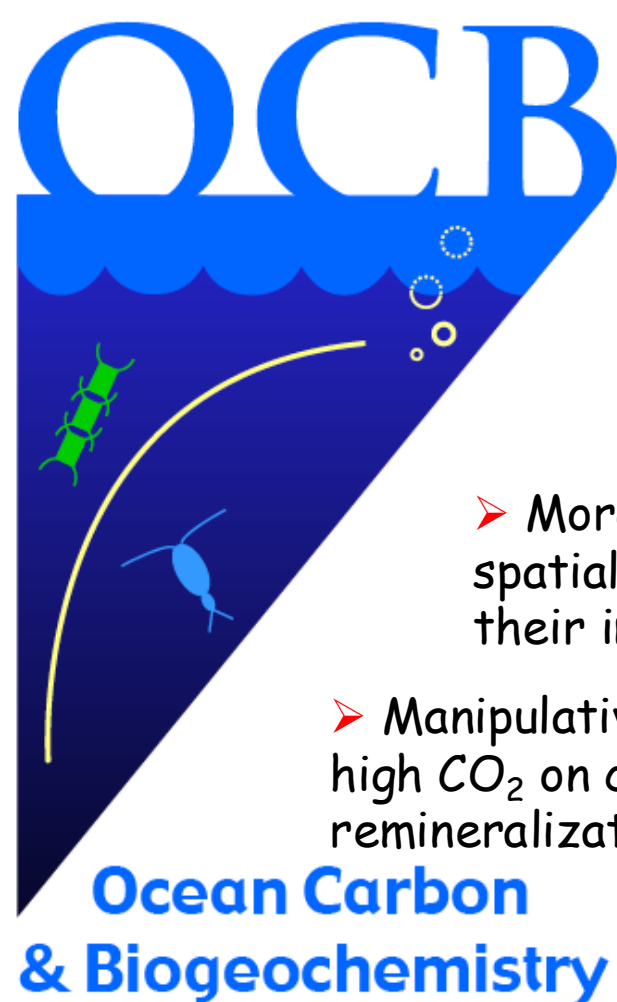
Scientific Questions

- What are the temporal and spatial changes of the carbon system in the global oceans and their impacts on biological communities and ecosystems?
- Will marine calcifying organisms be able to acclimate to elevated CO_2 and/or temperature if given sufficient time?
- How are certain species able to adapt to life in low saturation state water?
- What are the impacts of high CO_2 on calcification, respiration, reproduction, settlement and remineralization?
- What are the effects of high CO_2 on the processes that affect ecosystem responses and global feedbacks?



Workshop Outcomes

- Each of the four ecosystem focus groups (coral reefs, coastal regions, high-latitude pelagic, & low-latitude pelagic) devised research implementation strategies involving a mix of field observations and manipulative experiments to investigate potential impacts of ocean acidification on key ecosystem processes and organisms
- Timelines of research activities for the next 10 years were formulated by each ecosystem group
- Specific research implementation strategies will be vetted by the community and the final report will be posted on the OCB website



Conclusions

- Ocean acidification is a process that could be impacting present day and future marine ecosystems in ways that we are just beginning to recognize and understand.
- More research is needed to determine the temporal and spatial changes of the carbon system in the global oceans and their impacts on biological communities and ecosystems.
- Manipulative experiments will help us understand the impacts of high CO_2 on calcification, respiration, reproduction, settlement and remineralization.
- Long term experiments are necessary to observe if marine calcifying organisms will be able to acclimate to elevated CO_2 and/or temperature if given sufficient time.
- We need to discover how certain species are able to adapt to life in low saturation state water.
- We need to know the effects of high CO_2 on the processes that affect ecosystem responses and global carbon feedbacks.

Coral Reef Program

Preliminary Research Objectives

- Improve our predictive capability of the geochemical response of reef systems to continued ocean acidification in combination with other variables
- Understand temperature/saturation state/nutrient interactions - (average changes as well as in variability)

- Dissolution at multiple levels (organism to reef) also in terms of possibility of local buffering in certain reef habitats - atoll-size scale
- What are the effects on community structure and their repercussions through the ecosystem - who are winners and losers in terms of ocean acidification?
- Retrospective analyses (paleostudies of the last few 1000 years) provide a baseline of reef accretion processes
- Resolve issues with solubility of mineral phases, kinetic issues
- Develop carbonate chemistry measurement protocols
- Improve remote sensing capabilities with high-spatial/high spectral resolution
- Explore molecular/genomic level of calcification (relative sensitivities of different species to saturation state - then identify the genetics of least and most sensitive)