

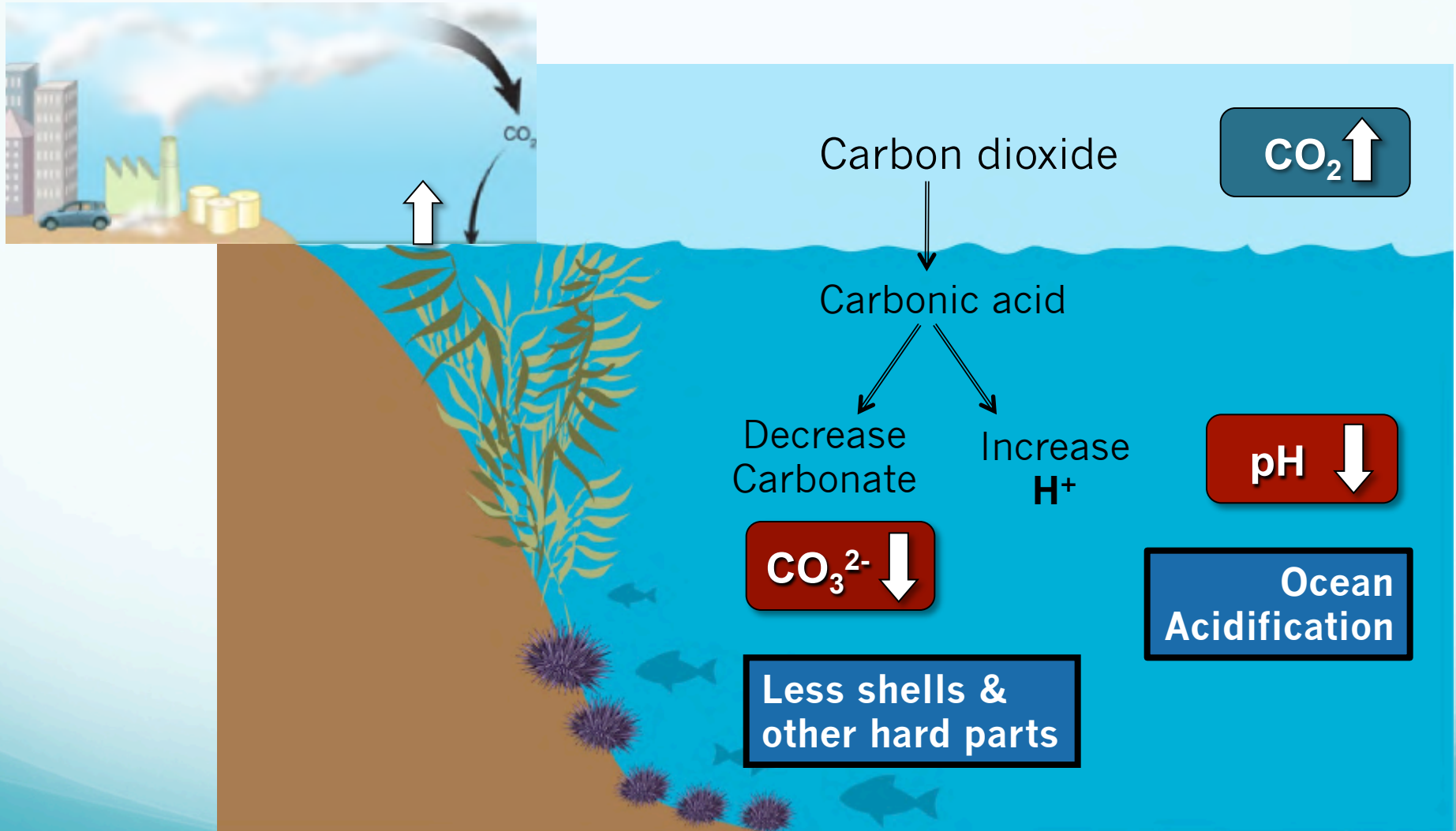
Ocean Acidification

Simona Bartl, Education Seat, Monterey Bay SAC
Karen Grimmer, Resource Protection Coordinator, MBNMS

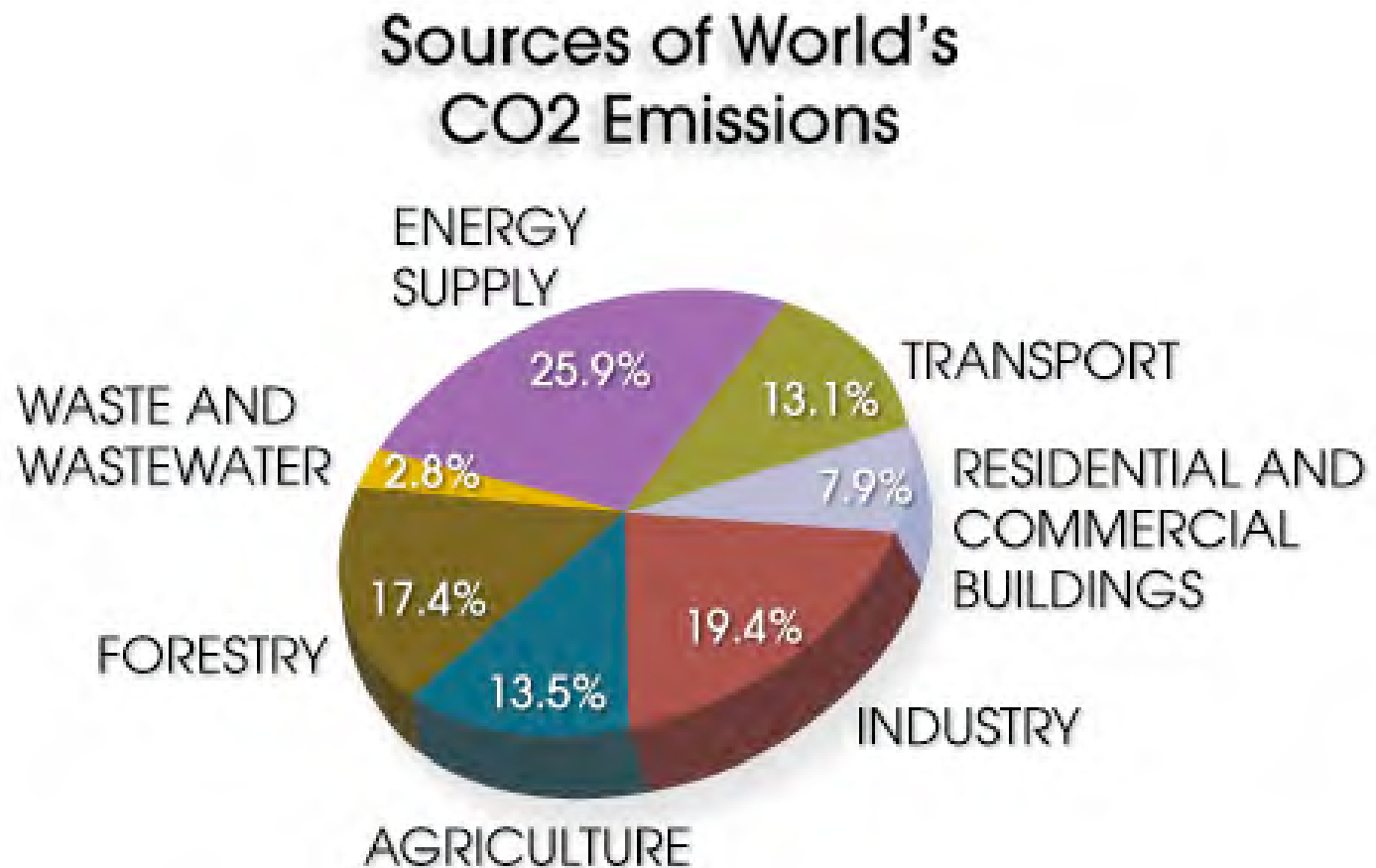
February 7, 2013

Some content from presentations by
Dr. Joanie Kleypas, NCAR, and Laura Frances, CINMS

How does it happen?



Atmospheric CO₂ Sources



What might it mean?

- Conference Findings
 - Ocean is Acidifying Rapidly
 - Compared to Historical events
 - Just One of Many Stressors
 - Variability in Biological Responses
 - Some Case Studies
 - Some Predictions
 - Working towards Better Predictions

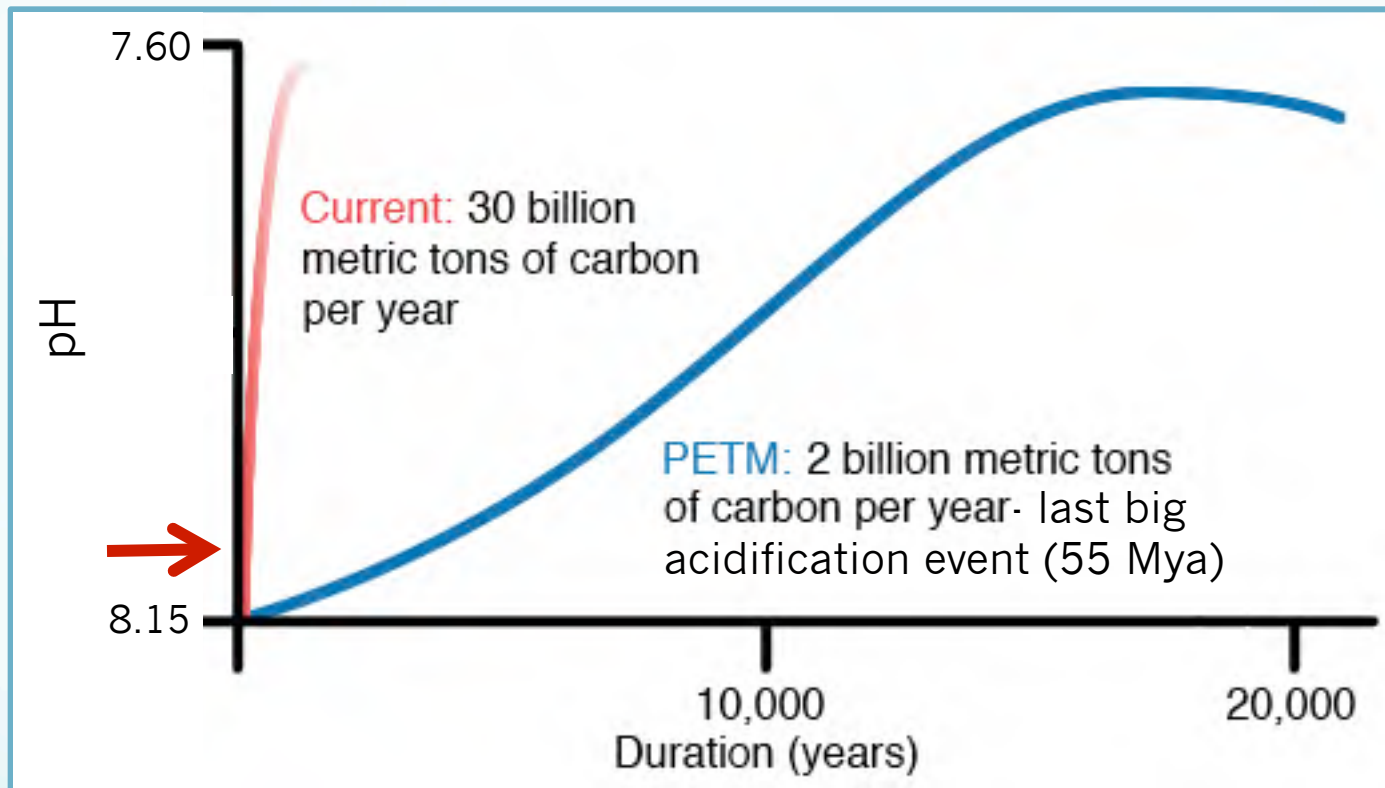


The Ocean in a High-CO₂ World

Ocean Acidification

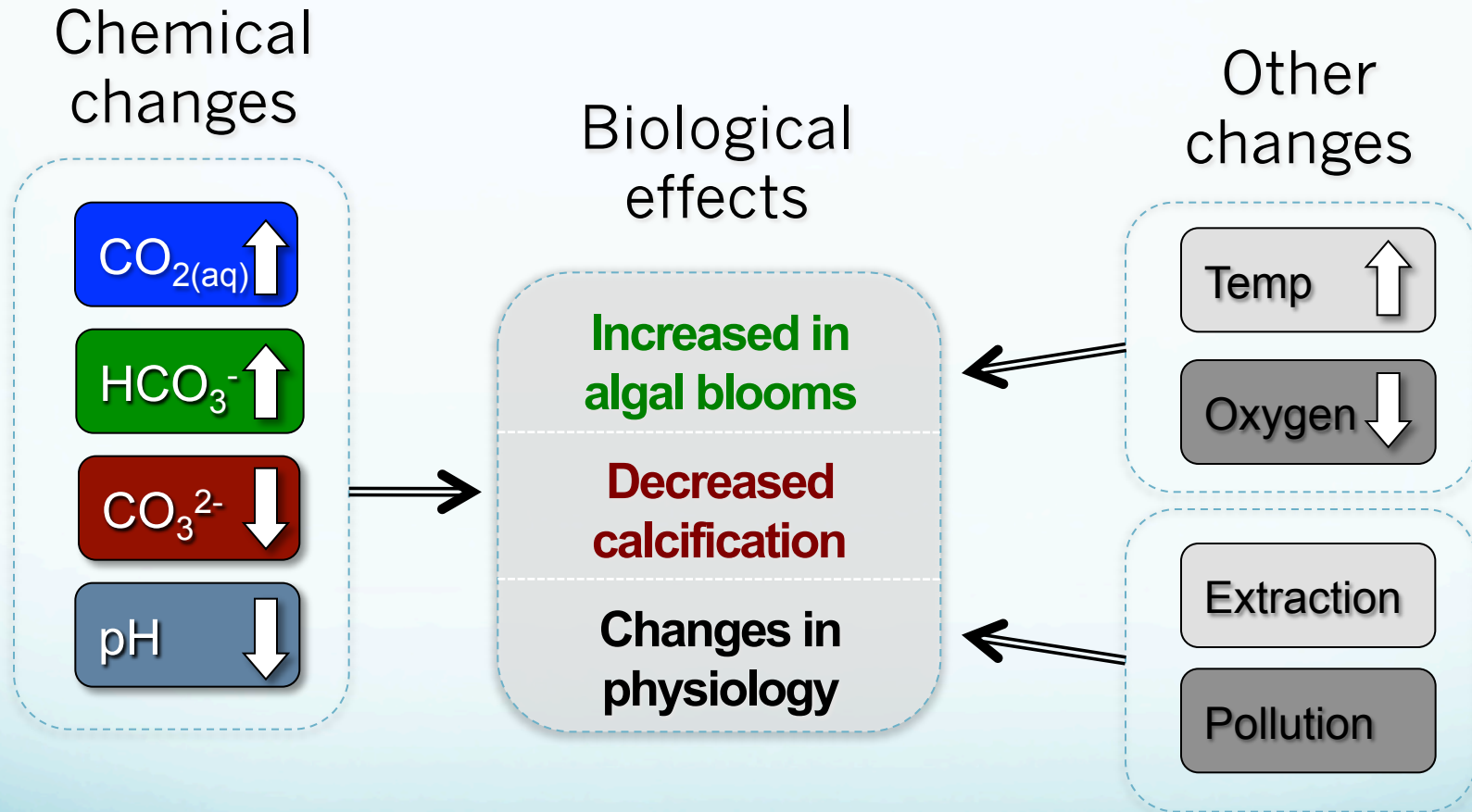
Third Symposium • Monterey • California • 24-27 September • 2012

Ocean is Acidifying Rapidly



- **Physical Ocean Changes:** Acidification, Warming, Deoxygenation, Circulation Reversed
- **Marine Biological Responses:** Plankton Blooms, Extinctions, Species Turnovers, Changes in Calcification

Just One of Many Stressors



Variability in Biological Responses

Some marine plants (algae, grasses, plankton) do better but not all

- Increased toxicity of harmful algae blooms - HABs

Potential for adaption and evolution by marine species

- Evolution is a slow process that needs time

Corals will decline, some species and regions faster than others

Some developmental stages are more sensitive

Marine life is exposed to many stressors and responds in complex ways.

Some Case Studies

Development

- 5 year failure in the recruitment of the Pacific Northwest oyster larvae

Behavior

- Impaired ability of juvenile clownfish to detect predators

Biodiversity

- Champagne sites – with natural CO₂ bubbling from ocean floor
- Helps predict effects on biodiversity



Photo credit: Lynn Ketchum, OSU

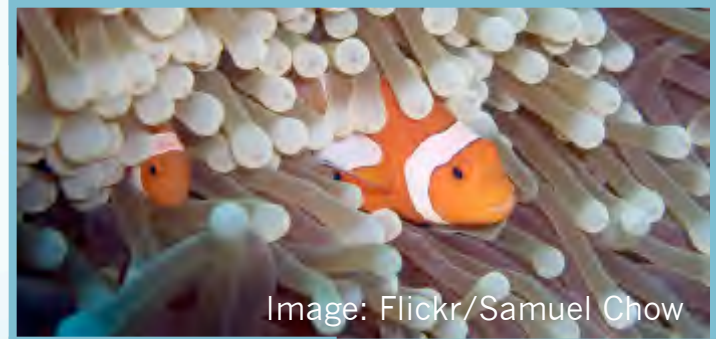


Image: Flickr/Samuel Chow

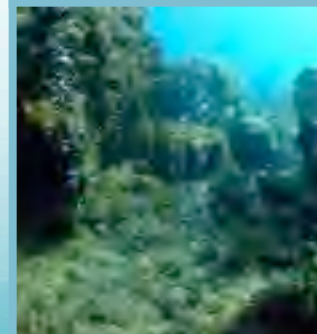


Photo credit:
Katharina Fabricius/
Australian Institute of
Marine Science

Some Predictions



Fabricius et al. (2010) *Nat Clim Change*

Loss of Biodiversity

- Some species will decline, others will increase, some will go extinct - net loss of biodiversity

Socio-economic impacts

- Fisheries & Tourism
- Human health & well-being
- Ecosystem services

Working towards Better Predictions

**CO₂ enrichment
in the Deep Sea**



**CO₂ enrichment in
the Open Ocean**



**CO₂ enrichment on the
Great Barrier Reef**



What can we do?

- Talk to your constituents
 - Only 10% of Americans feel informed about OA
- Learn more about OA and Carbon Emission Policies and Action Plans
 - Local, state, and national level
- Share success stories
- Take action

Share Success Stories

C40 Cities

- 58 cities
- 1 in 12 people worldwide
- 4,734 collective actions

Blue Ribbon Panel on Ocean Acidification (WA state)

- Washington Shellfish Initiative
 - Restore and expand shellfish resources

Many others at the international, regional, and local levels



West Coast Ocean Acidification Action Plan



National Marine Sanctuaries of the West Coast

Ocean Acidification Action Plan

Dave Lott WCR, Ed Bowlby OCNMS, Dan Howard CBNMS, Kelley Higgason GFNMS, Karen Grimmer MBNMS, Laura Francis CINMS, Linda Krop CINMS SAC, Richard Feely PMEL, Libby Jewett OAR

August 5, 2011

Strategy 6 – Demonstrate Leadership by Reducing Carbon Emissions

West Coast Ocean Acidification Action Plan

Strategy 6 – Demonstrate Leadership by Reducing Carbon Emissions

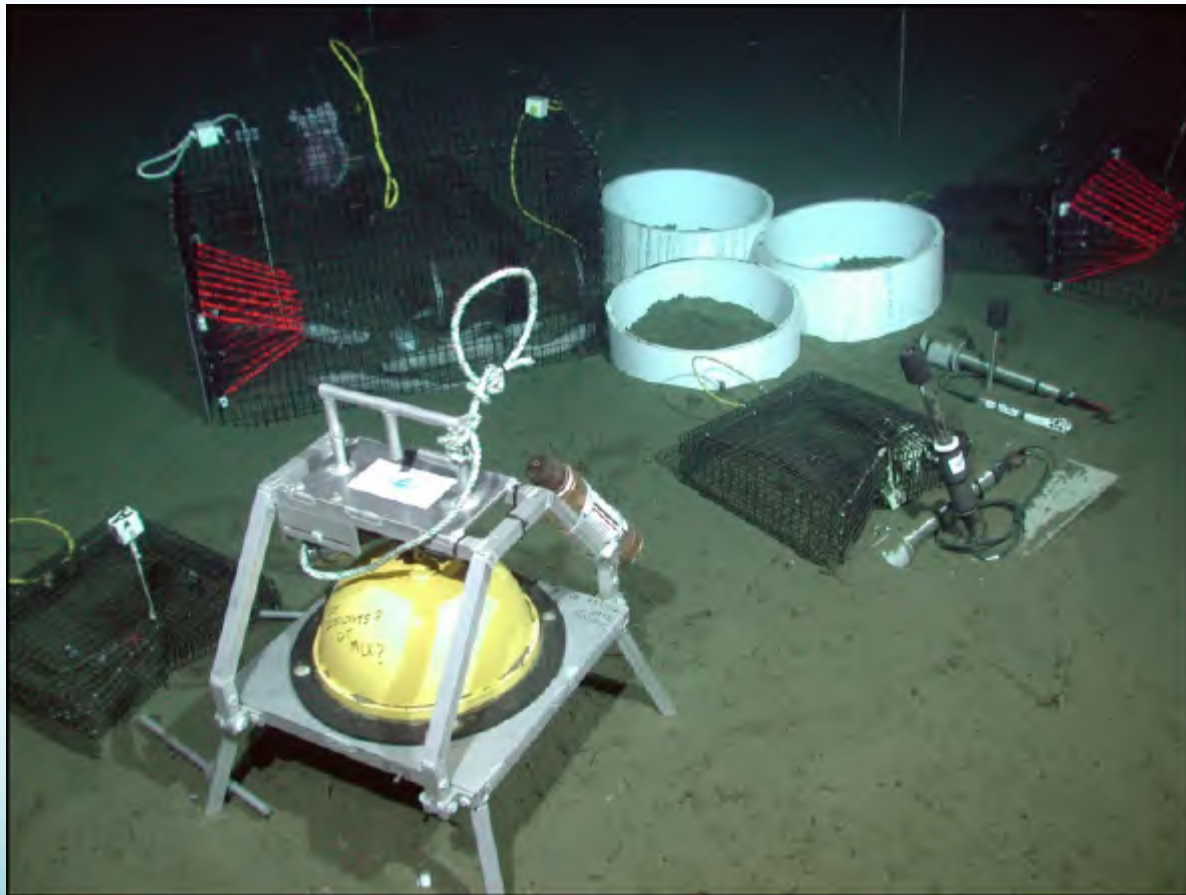
- Activity 6.1 Inventory greenhouse gas emissions
 - Each site will conduct a baseline greenhouse gas emission inventory resulting from facility use
- Activity 6.2 Greening the Sanctuaries - Best Practices for Facilities and Operations
 - Visitor centers: ONMS will incorporate principles of sustainable design and energy efficiency into all of its building projects, including visitor centers
 - – e.g. Exploration Center LEED Gold
- Activity 6.3 Encourage reductions in carbon emissions by sanctuary users
 - AMBAG Sustainable Communities Strategy
 - – Senate Bill 375
 - Climate Action Plans – Cities around Monterey Bay
 - Other actions around the Bay

Monterey Bay Actions



Monterey Bay Research on OA

30 plus research projects are currently underway in MBNMS



MBARI ROV frame grab of an early benthic biology / CO₂ exposure experiment.

OA Resources

Information websites

- http://www.ambag.org/programs/met_transp_plann/sb375.html
- <http://centerforoceansolutions.org/climate/>
- http://sanctuarysimon.org/regional_sections/climate-change/overview.php
- <http://www.epoca-project.eu/index.php/what-is-ocean-acidification/faq.html>

Action websites

- <http://www.ecy.wa.gov/water/marine/oceanacidification.html>
- <http://www.c40cities.org/takeaction>
- <http://www.centerforoceansolutions.org/montereybay/action-around-bay>
- <http://oceanacidification.noaa.gov/>

Ocean Chemistry

Atmospheric carbon dioxide

