National Ocean Acidification Observing Network

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Ocean in High CO2 World Symposium
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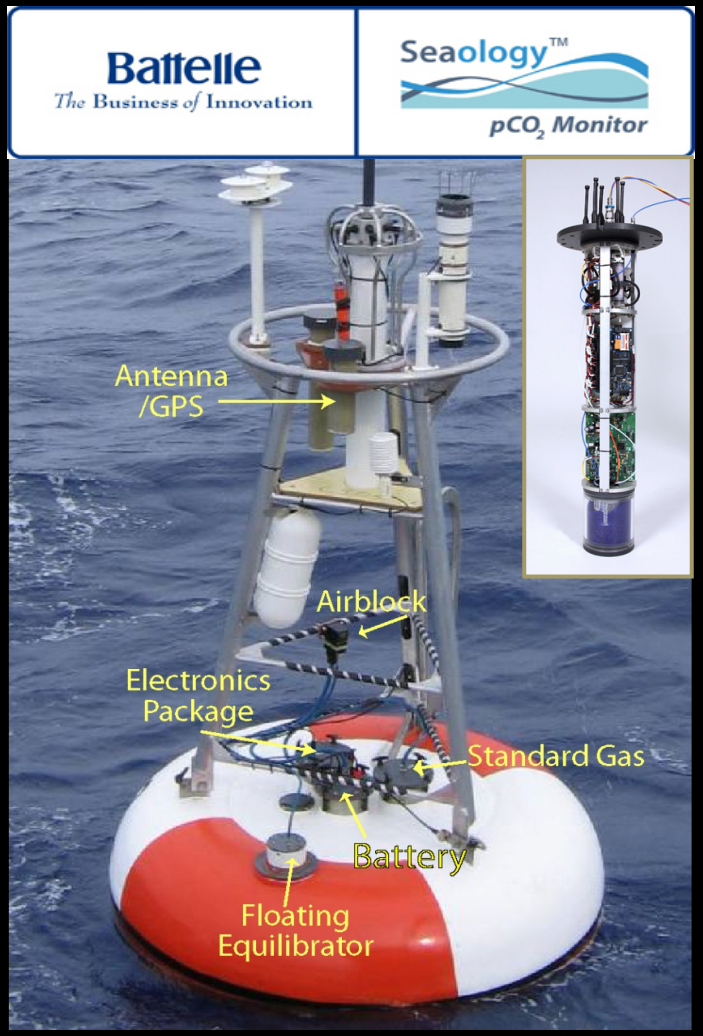
Vision

"This network will provide a better understanding of the temporal and spatial scales of variability in ocean carbon chemistry and biology and the observational basis for developing predictive models for future changes in ocean acidification and its consequences for marine ecosystems."

- NOAA Ocean and Great Lakes Acidification Research Plan, 2010

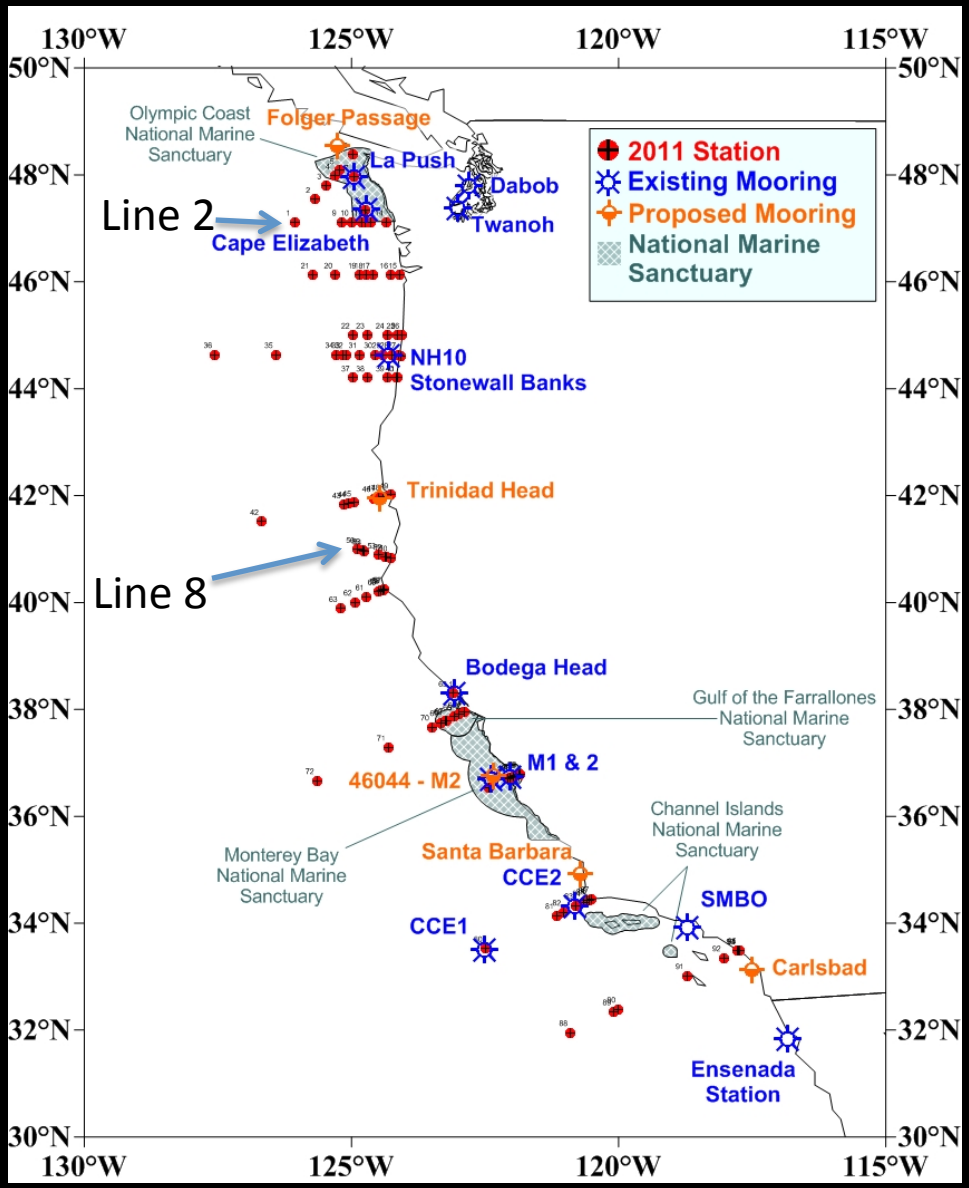
Ocean Acidification Observing

- Fixed site observing platforms
- Ships of opportunity
- Repeat hydrography and dedicated OA cruises
- Biogeochemical Modeling
- New technologies

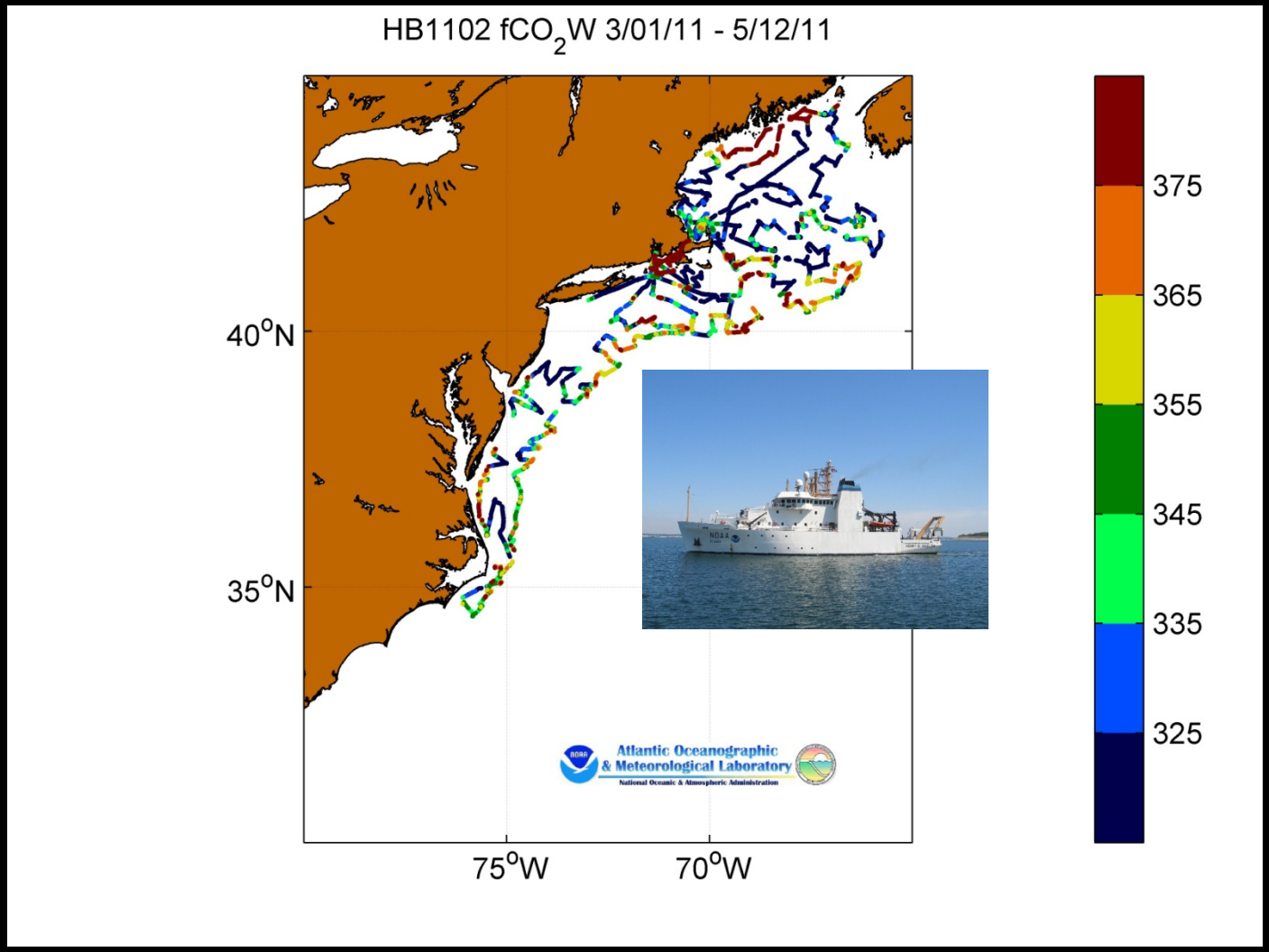


Coastal OA Survey Cruises

The West (and East/Gulf) Coast OA Cruises are designed to delineate the extent and magnitude of the exposure of US coast ecosystems to "acidified" conditions.



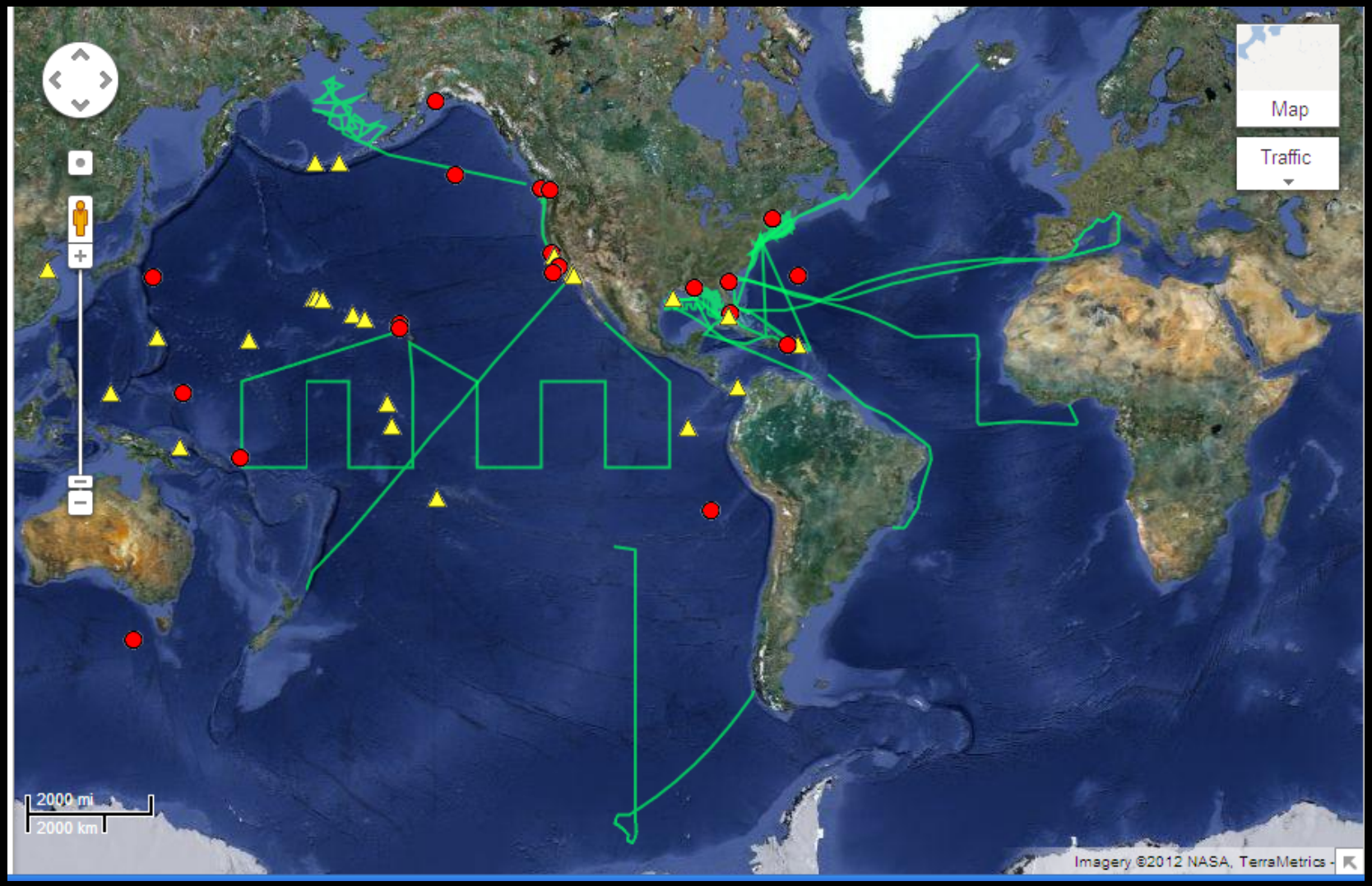
Ships of Opportunity



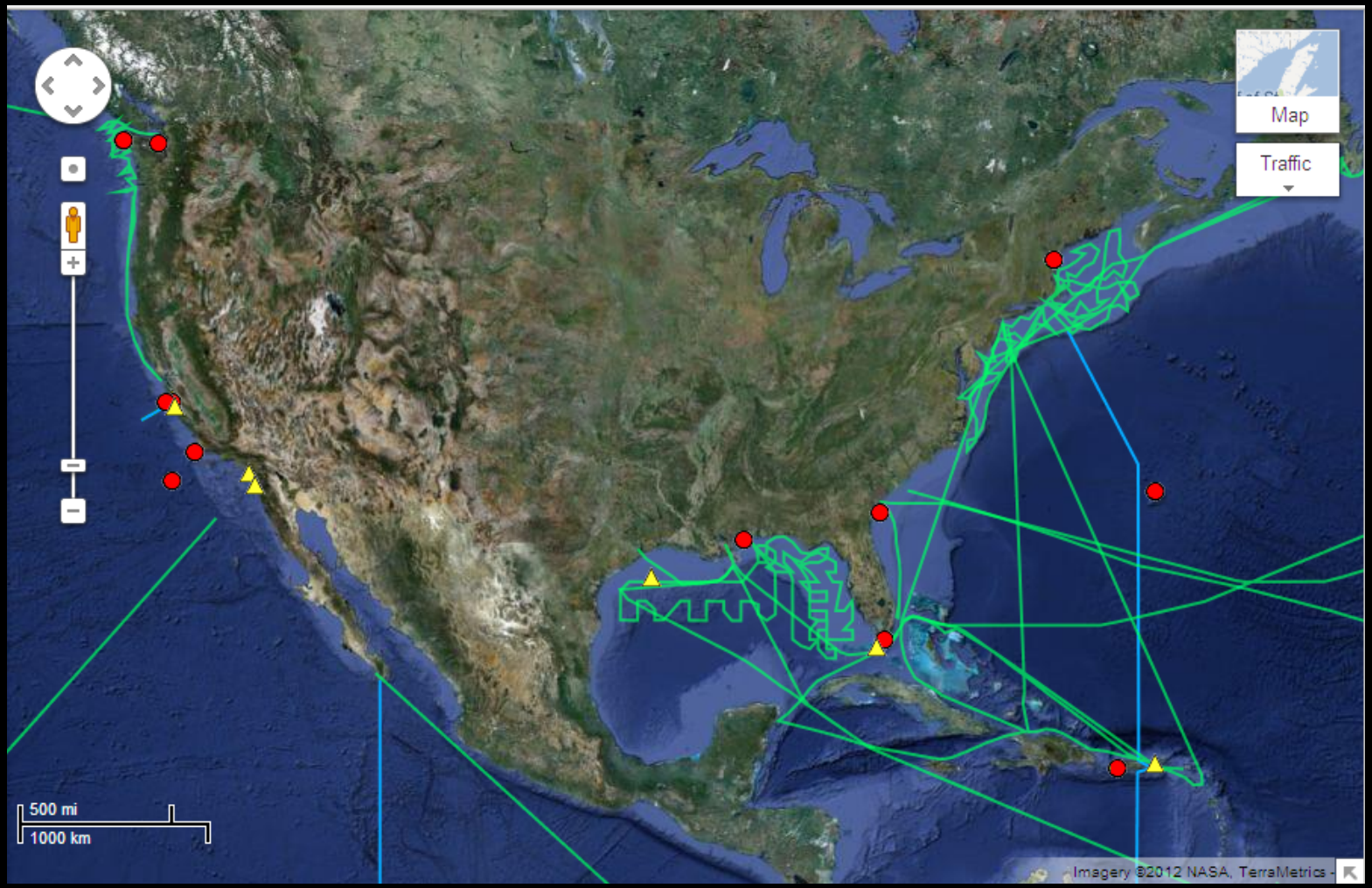
AOML and NMFS: First surface water CO_2 data from NOAA ship *Henry B. Bigelow*

New Technologies

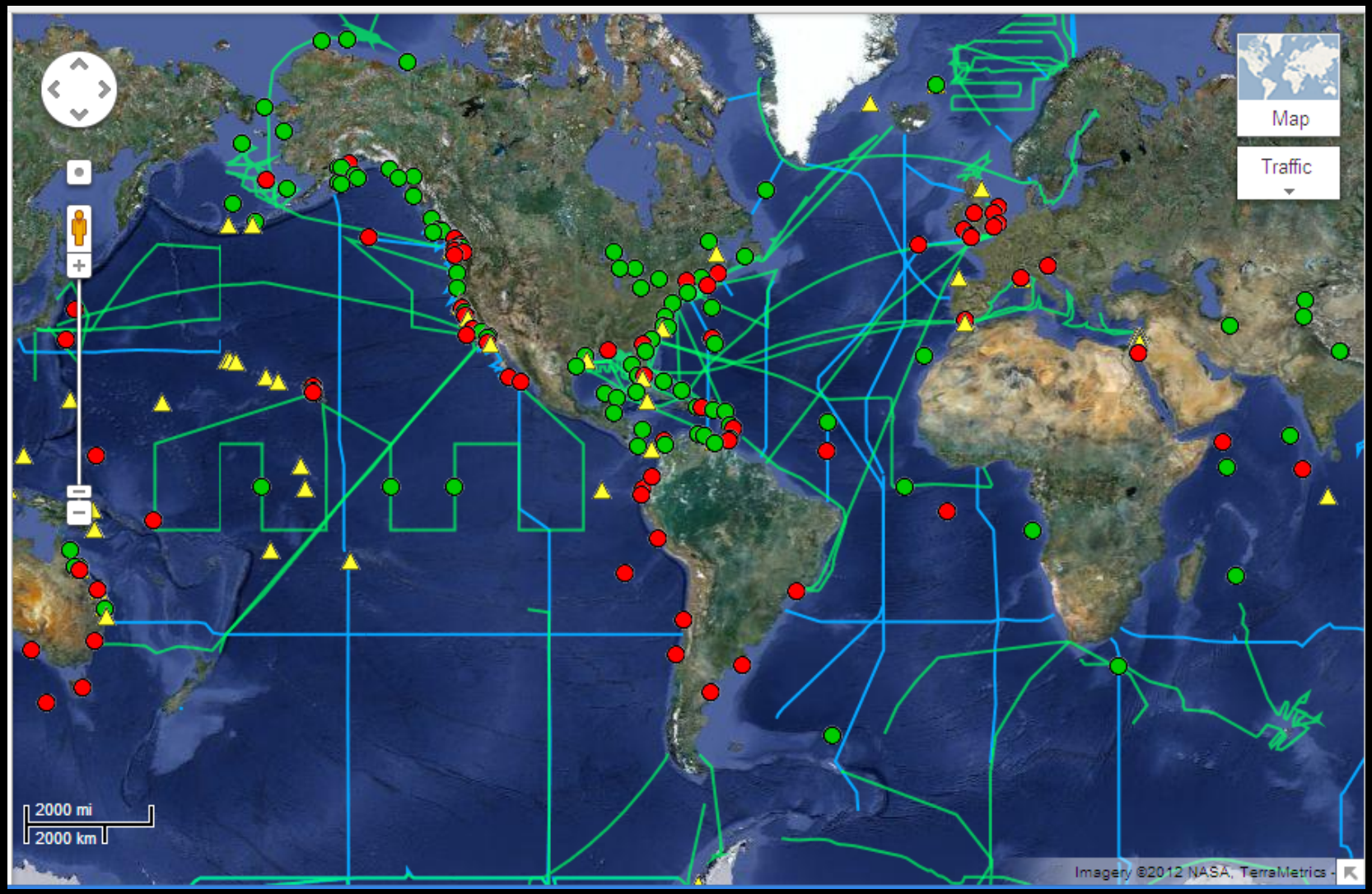
US-funded Observing Network



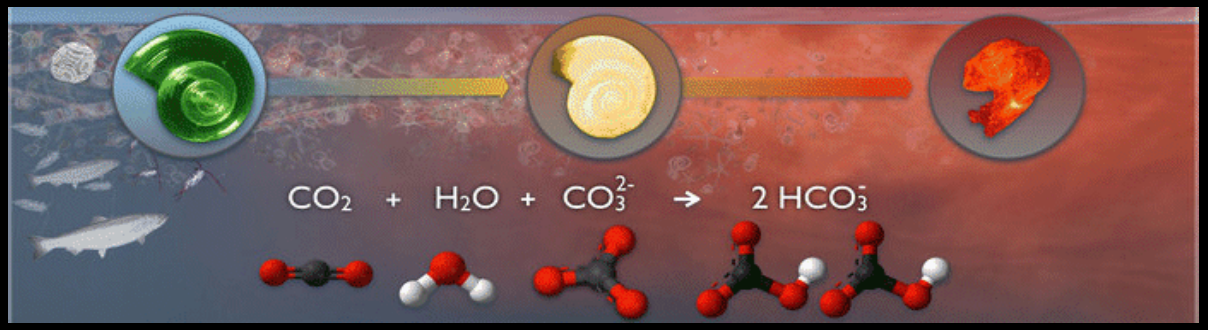
Lower 48 Network



International Observing Network

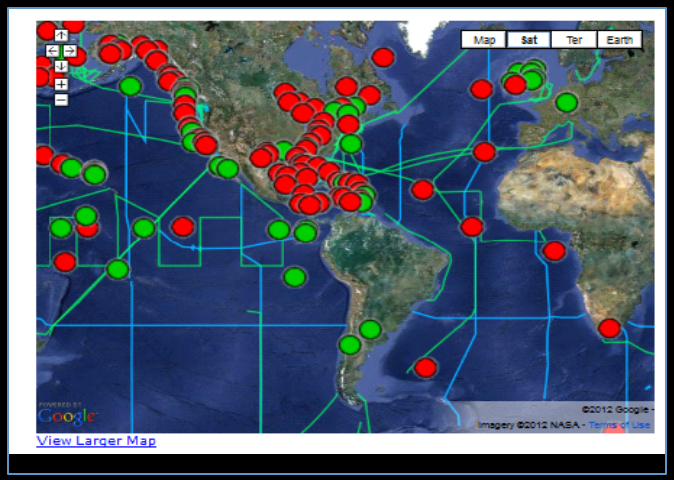


http://www.pmel.noaa.gov/co2/story/International+Workshop+-+Ocean+Acidification



Toward a Global Ocean Acidification and Ecosystem Response Observing Network

An international workshop held at the
University of Washington
Seattle, WA, USA
26-28 June 2012



NOAA

Intergovernmental Oceanographic Commission

The Global Ocean Observing System

GOOS

IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

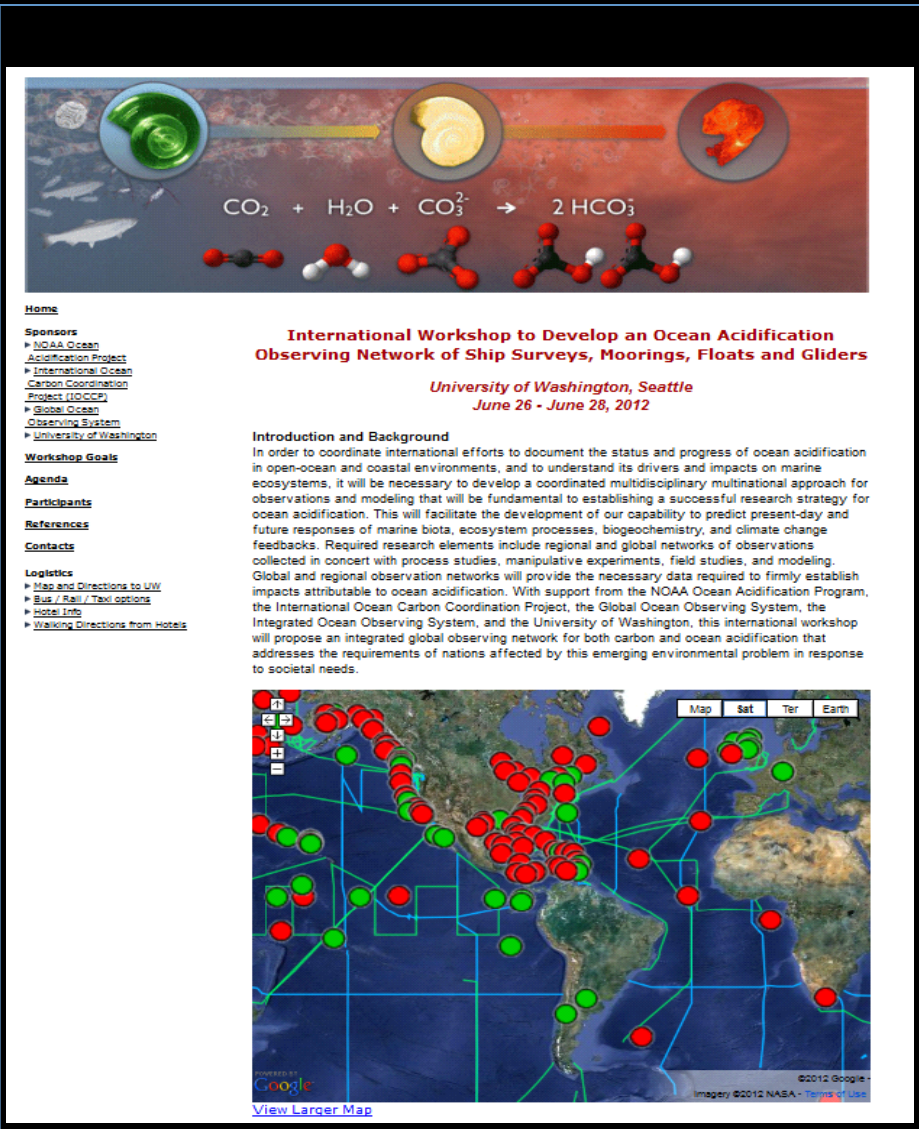
W

International Observing Workshop Goals

1. Provide the **rationale and design** of the components and locations of an international carbon and ocean acidification observing network that includes repeat hydrographic surveys, underway measurements on volunteer observing ships, moorings, floats and gliders taking into account existing networks and programs wherever possible;
2. Identify a **minimum suite** of measurement parameters and performance metrics for each major component of the observing system; and
3. Develop a **strategy** for data quality assurance and data distribution; and
4. Discuss **requirements** for program integration at the international level.

Workshop Participants

- 62 scientists from 23 countries
  - Carbon chemists, oceanographers, biologists, a few data managers, modelers
  - USA, Australia, Sweden, Venezuela, Bermuda, Taiwan, China, Canada, New Zealand, UK, Mexico, Norway, Chile, Korea, China, South Africa, Japan, Iceland, India, Israel, Italy, Germany, France
- These participants and more indentified existing (green) and planned (red) OA observing assets



WHAT the network needs to provide

Goal 1. An understanding of **<u>global OA conditions</u>**:
Identify spatial/temporal patterns and assess generality of response; document and assess variation to infer mechanisms driving condition; quantify rate of change and ID areas of vulnerability

Goal 2. An understanding of **<u>ecosystem response to OA</u>**:
Measure biological responses to physical/chemical changes; quantify rate of change and ID areas of vulnerability

Goal 3. Input data to **<u>optimize modeling for OA</u>**:
Provide spatially and temporally resolved data for model initial conditions and evaluation; then use model output to aid #1-2

Goal 1 Level 1 Measurements

- T, S, O, Carbonate-system Constraint
- Fluorescence* and Irradiance*

**Except where platform is not appropriate or available for this measurement*

Carbonate-system constraint can be achieved in a number of ways, including combinations of measurements and synthetic, non-collocated estimates of other parameters.

Goal 2 Level 1 Measurements

Ocean: *(in addition to phys/chem)*

Biomass of functional groups:

- Phytoplankton: timing of bloom, community shifts
- Zooplankton
  - micro (e.g., protists)
  - meso (meroplankton, multicellular)
- Microbes

Coast: *(in addition to Ocean)*

- Benthic animals, algae, and plants

Goal 2 Level 1 Measurements

Coral Reef:

- Processes:

  Calcification/Dissolution (Net Ecosystem Calcification)
  Production/Respiration (Net Primary Prod'n)

- Sensors/Measurements:

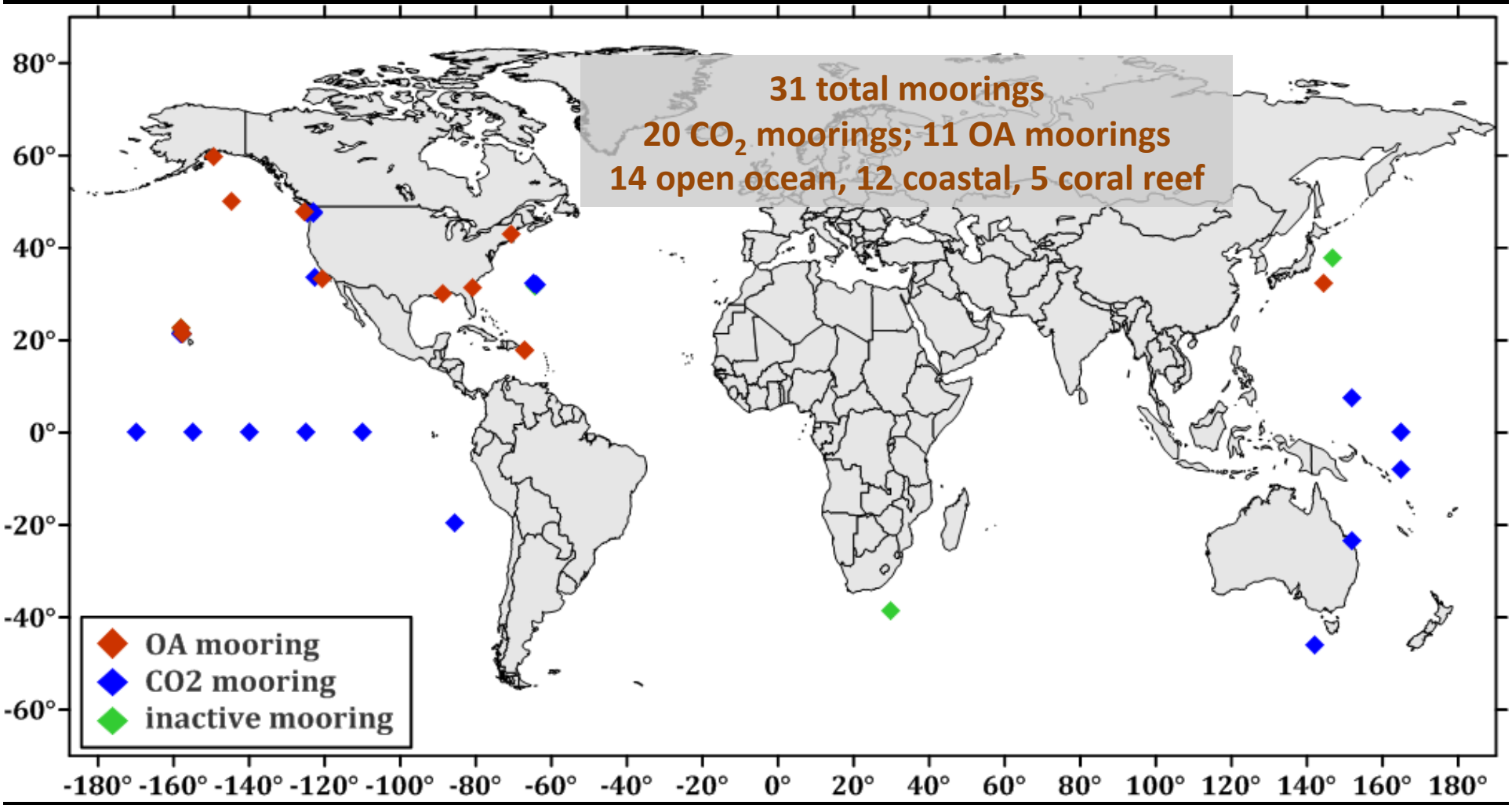
  DIC, TA, O2, T, S, Light, current

- Biomass/abundance of functional groups:

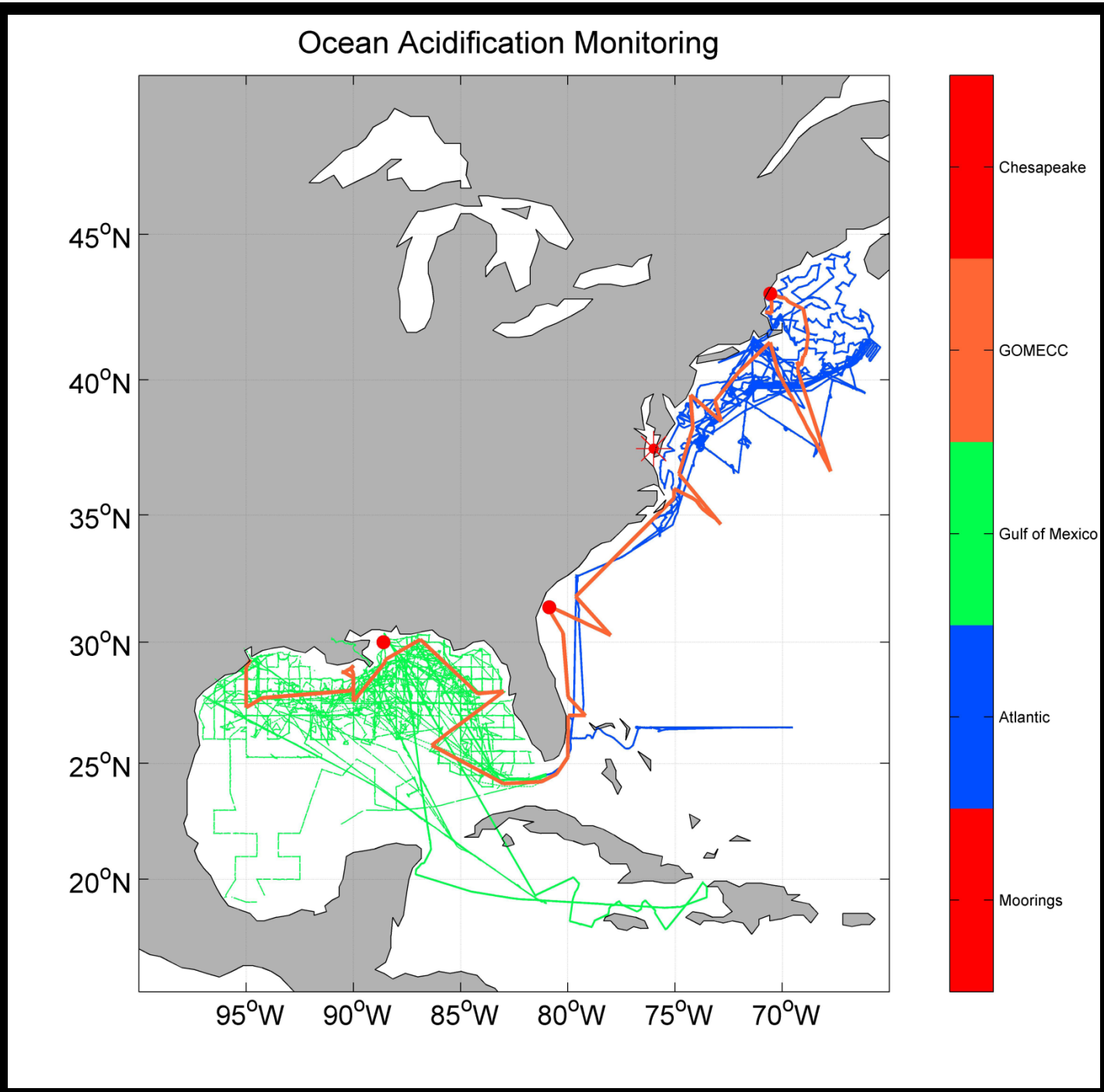
  Corals, macroalgae/turf algae, coralline algae
  (to assess shifts)

Questions?

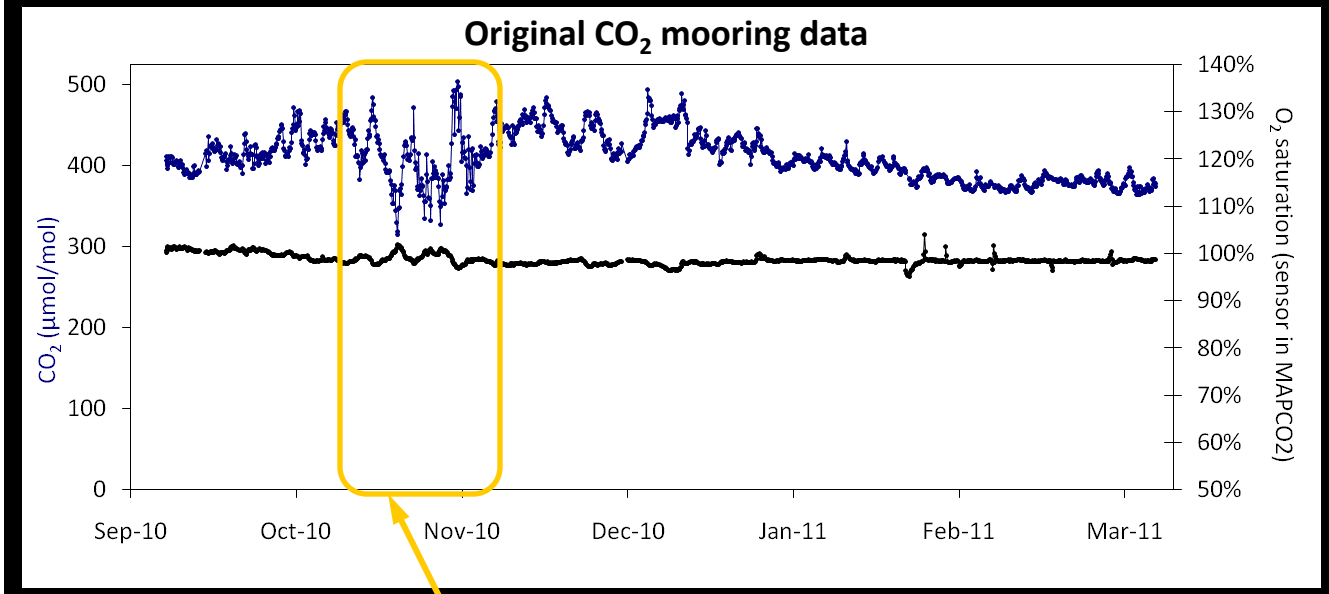
NOAA PMEL Mooring Network



Supported by NOAA's Office of Climate Observation (OCO), NOAA's Ocean Acidification Program, and a variety of partners

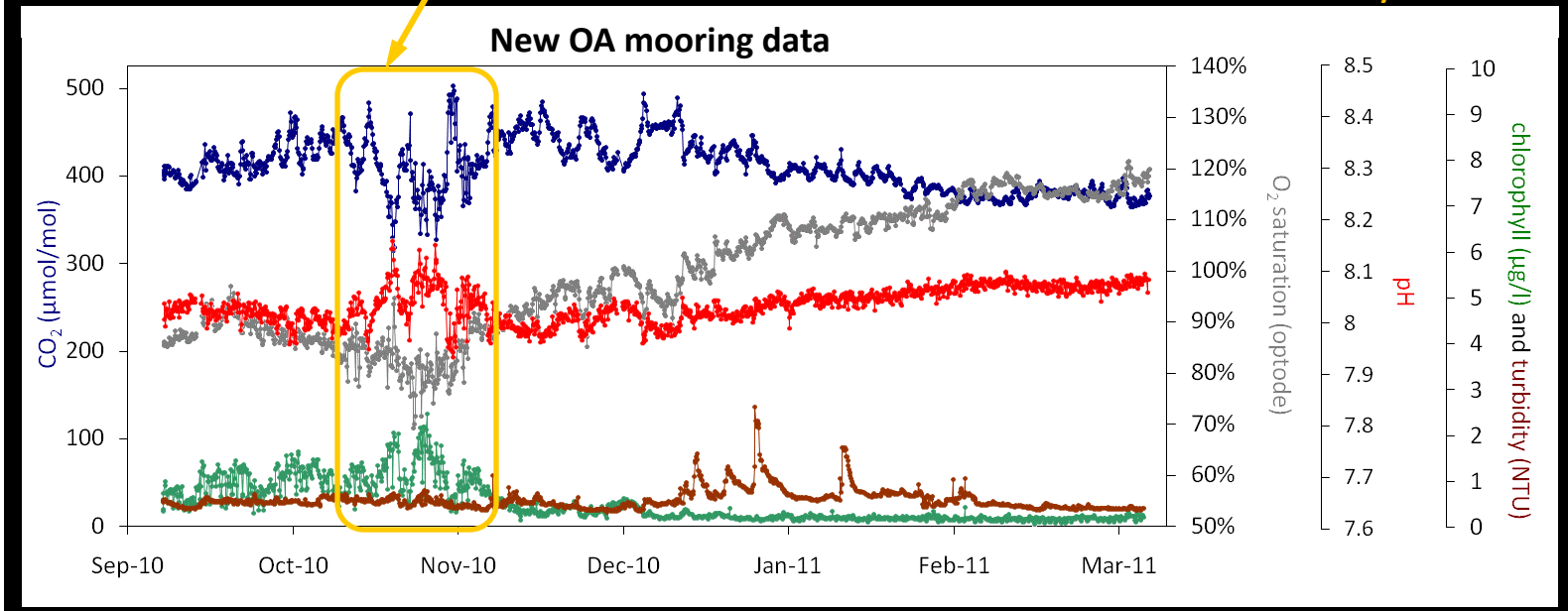

Ocean Acidification Monitoring
45°N
40°N
35°N
30°N
25°N
20°N
95°W
90°W
85°W
80°W
75°W
70°W
Chesapeake
GOMECC
Gulf of Mexico
Atlantic
Moorings

Gulf of Maine OA Mooring



CO_2 mooring data:
CO_2
O_2 in equilibrated air

New sensors provide insights into the influence of biology on short-term variations in ocean carbon chemistry

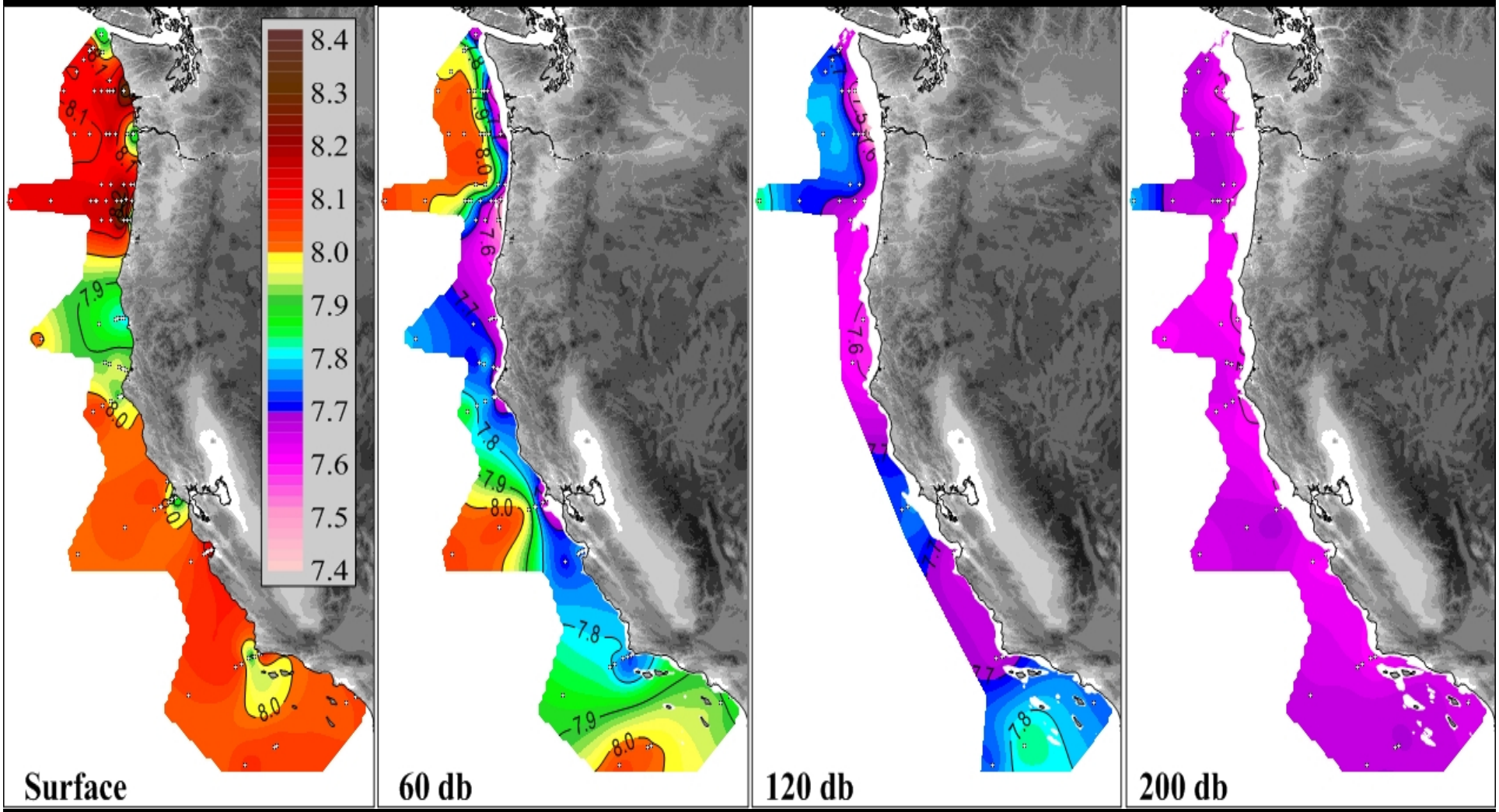


OA mooring data:
CO_2
pH
SSTC
optode O_2
fluorescence
turbidity

NOAA West Coast Ocean Acidification Program

Continental shelf carbon budgets, dynamics, and processes

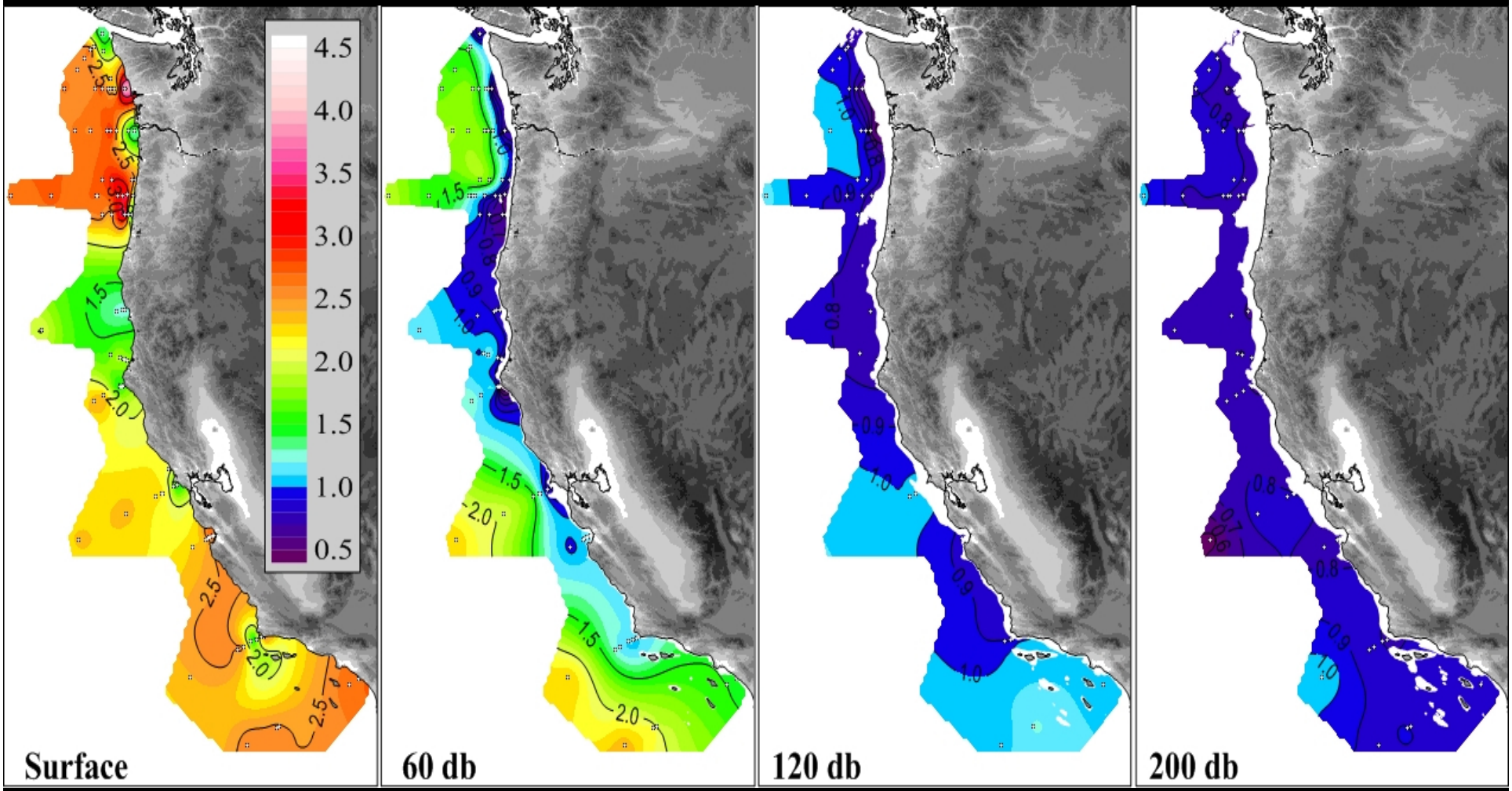
2011 August – September pH distribution

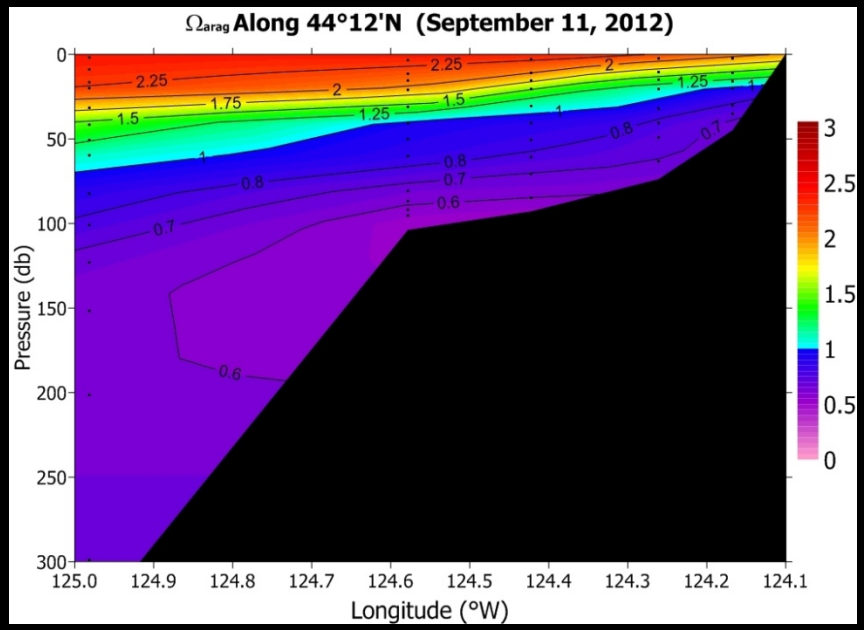


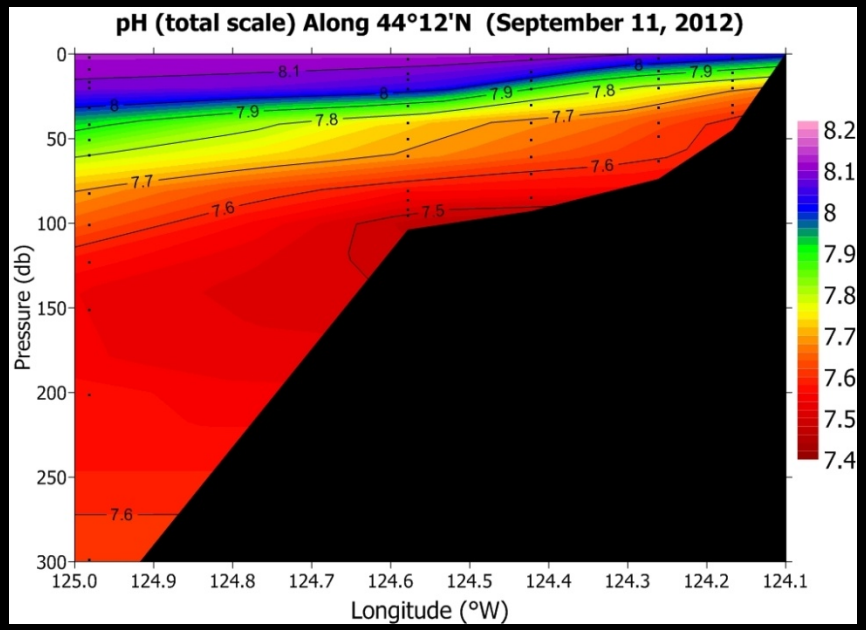
NOAA West Coast Ocean Acidification Program

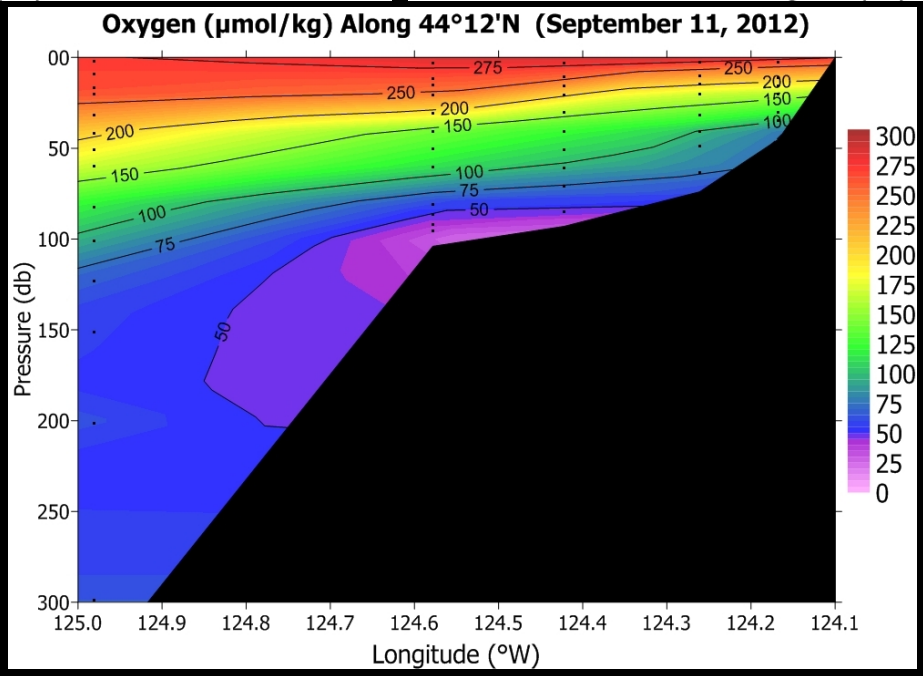
Continental shelf carbon budgets, dynamics, and processes

2011 August – September aragonite saturation state




Ω_{arag} Along 44°12'N (September 11, 2012)
Pressure (db)
Longitude (°W)
0
50
100
150
200
250
300
125.0
124.9
124.8
124.7
124.6
124.5
124.4
124.3
124.2
124.1
2.25
2
1.75
1.5
1.25
1
0.8
0.7
0.6
3
2.5
2
1.5
1
0.5
0


pH (total scale) Along 44°12'N (September 11, 2012)
Pressure (db)
Longitude (°W)
0
50
100
150
200
250
300
125.0
124.9
124.8
124.7
124.6
124.5
124.4
124.3
124.2
124.1
8.1
8
7.9
7.8
7.7
7.6
7.5
8.2
8.1
8
7.9
7.8
7.7
7.6
7.5
7.4

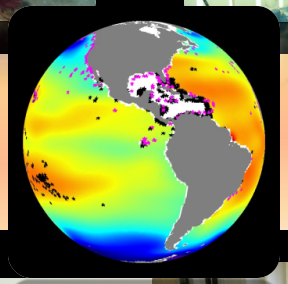

Oxygen (µmol/kg) Along 44°12'N (September 11, 2012)
Pressure (db)
Longitude (°W)
00
50
100
150
200
250
300
125.0
124.9
124.8
124.7
124.6
124.5
124.4
124.3
124.2
124.1
275
250
200
150
100
75
50
300
275
250
225
200
175
150
125
100
75
50
25
0

NOAA National Ocean and Great Lakes Acidification Research Plan

Monitor trends

Ecosystem Impacts

Model changes & responses



Develop adaptation strategies

Conduct education and outreach

Data management and synthesis

Carbon Wave Glider