

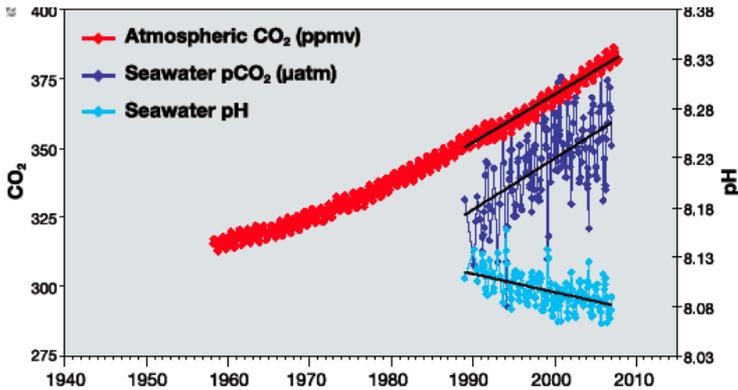
## Climate Variability : Ocean Acidification

Jan Newton, NANOOS, Alex Isern,  
NSF, Molly McCammon, AOOS, Roy  
Watlington, CaRA

# Regional Climate Change Activities



**Observations:** Single system – multiple uses  
 PMEL working with RAs to deploy CO2 sensors:  
 NANOOS; PacIOOS; CaRA, NERACOOS



**Data Management**  
 RT, trends, public display



**Integrated Coral Reef Monitoring**



**What is Climate Change?**

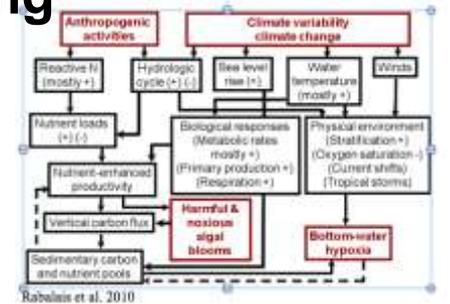
- Long term changes in the weather, over the course of decades affecting temperature, rainfall, cloudiness, etc.

**How does Climate Change affect Pacific Islands?**

- Sea level rise.
- Coastal flooding.

**Education Materials**

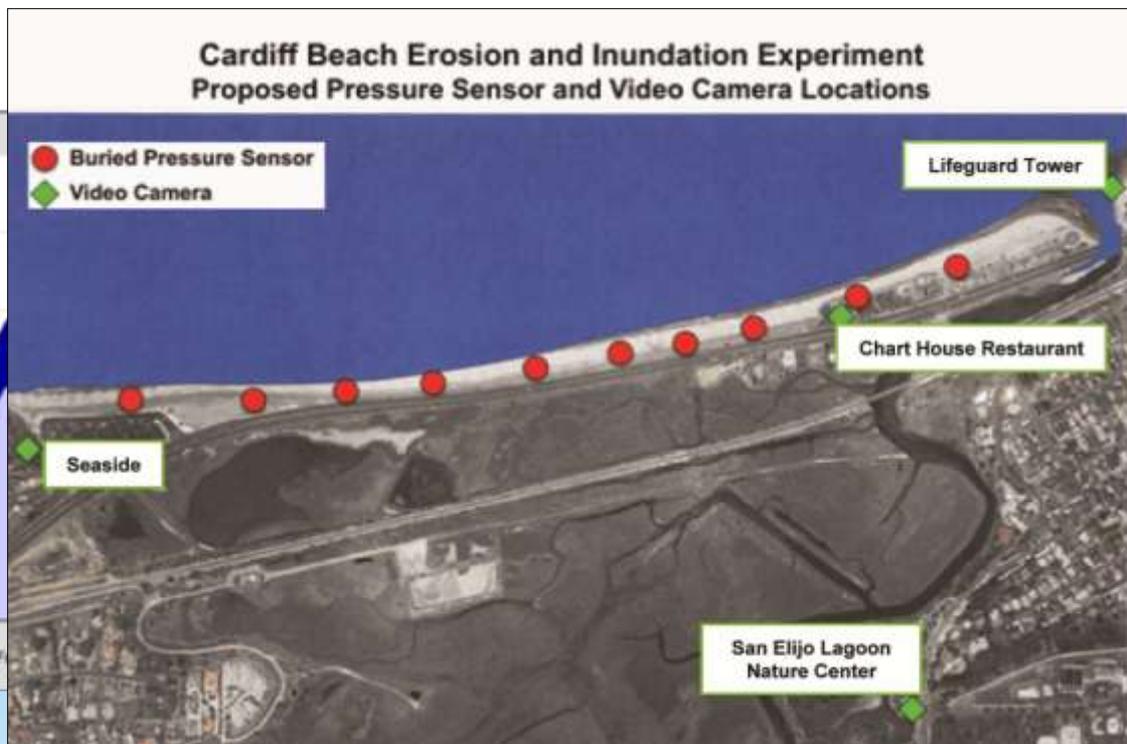
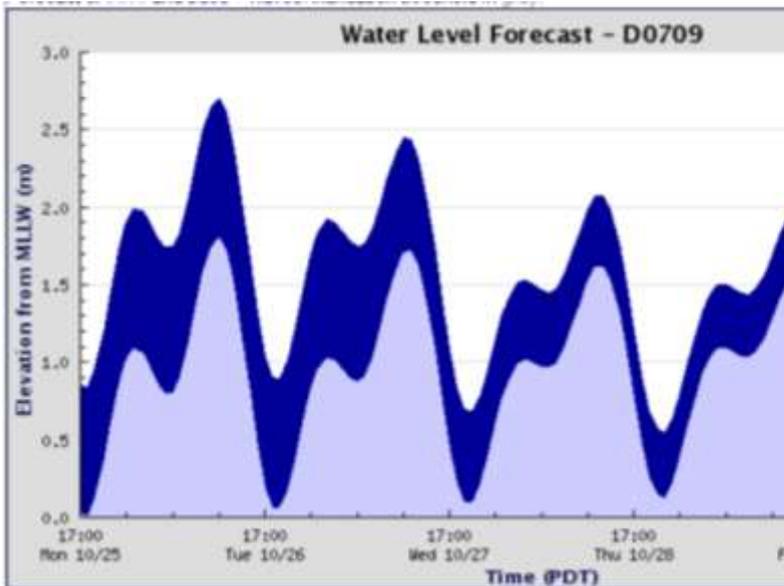
**Modeling**



Rabalais et al. 2010

# Climate Products: Inundation/Sea Level

Most RAs work with users on inundation and SLR

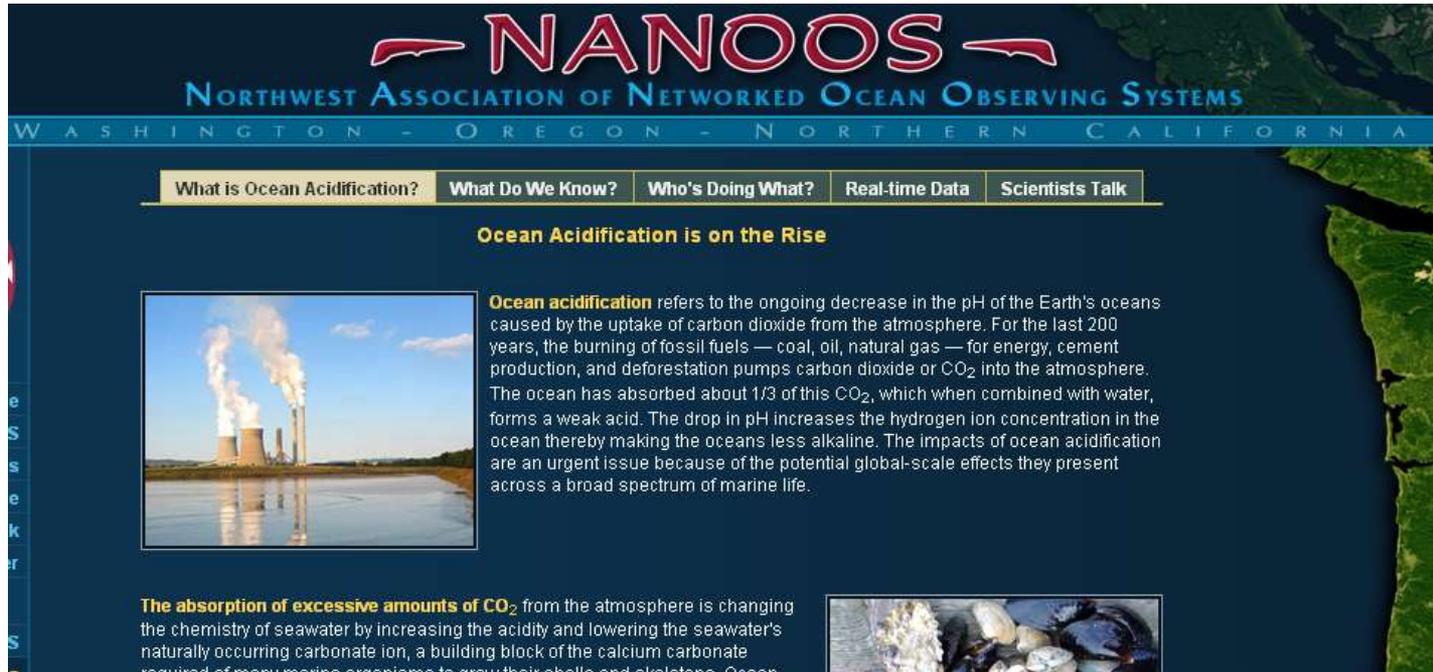


Automated 3-day E-mail warnings of potential inundation sent to City of Encinitas.



# Getting the word, and data, out:

“Theme page” on OA, with real-time data link



The screenshot shows the NANOOS website theme page. At the top, the logo "NANOOS" is displayed in a stylized red font with blue outlines, flanked by two blue arrows. Below the logo, the text "NORTHWEST ASSOCIATION OF NETWORKED OCEAN OBSERVING SYSTEMS" is written in blue. A blue banner below that contains the text "WASHINGTON - OREGON - NORTHERN CALIFORNIA". A navigation menu with five tabs is visible: "What is Ocean Acidification?", "What Do We Know?", "Who's Doing What?", "Real-time Data", and "Scientists Talk". The "What is Ocean Acidification?" tab is selected and highlighted in yellow. Below the navigation menu, the heading "Ocean Acidification is on the Rise" is displayed in yellow. To the left of the main text is a photograph of a power plant with several smokestacks emitting white plumes of smoke into a clear blue sky, with the plant's reflection visible in a body of water. To the right of the photograph is a text block explaining ocean acidification. Below the text block is a smaller photograph showing a close-up of a crab's shell and legs. At the bottom left of the page, there is a short paragraph starting with "The absorption of excessive amounts of CO<sub>2</sub> from the atmosphere is changing the chemistry of seawater by increasing the acidity and lowering the seawater's naturally occurring carbonate ion, a building block of the calcium carbonate required of many marine organisms to grow their shells and skeletons. Ocean".

**NANOOS**  
NORTHWEST ASSOCIATION OF NETWORKED OCEAN OBSERVING SYSTEMS  
WASHINGTON - OREGON - NORTHERN CALIFORNIA

What is Ocean Acidification? What Do We Know? Who's Doing What? Real-time Data Scientists Talk

**Ocean Acidification is on the Rise**

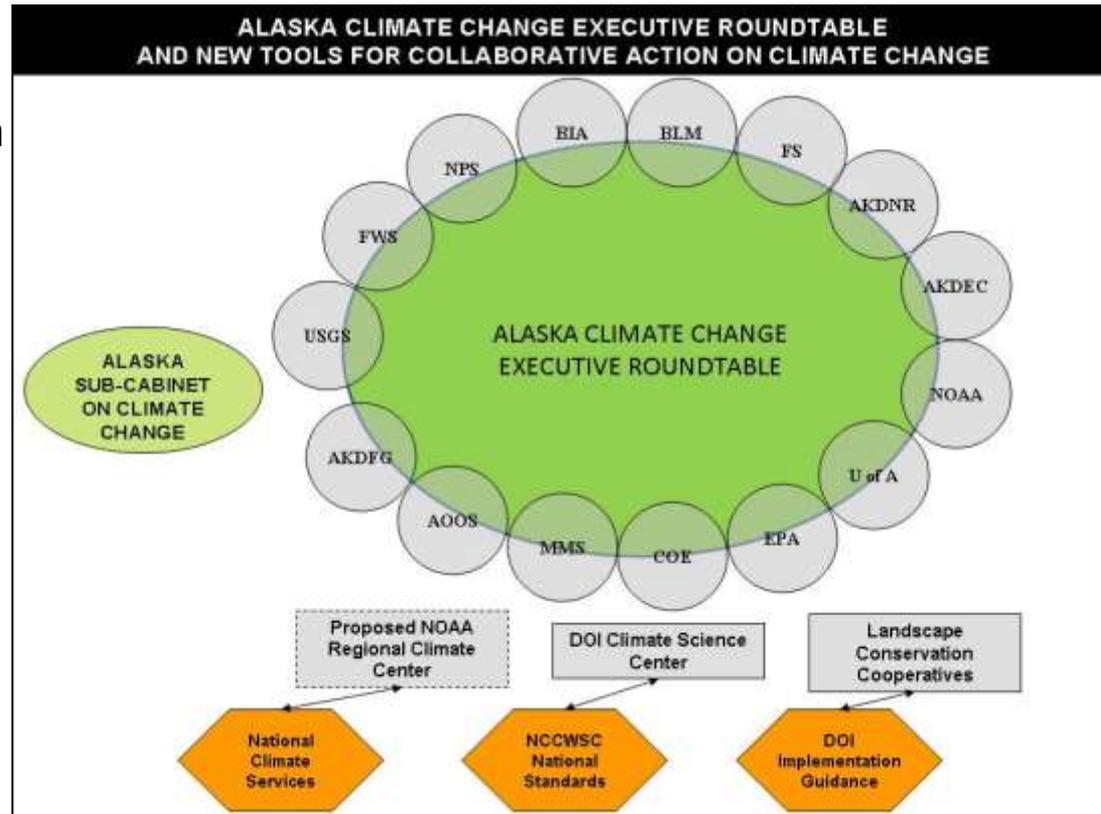
**Ocean acidification** refers to the ongoing decrease in the pH of the Earth's oceans caused by the uptake of carbon dioxide from the atmosphere. For the last 200 years, the burning of fossil fuels — coal, oil, natural gas — for energy, cement production, and deforestation pumps carbon dioxide or CO<sub>2</sub> into the atmosphere. The ocean has absorbed about 1/3 of this CO<sub>2</sub>, which when combined with water, forms a weak acid. The drop in pH increases the hydrogen ion concentration in the ocean thereby making the oceans less alkaline. The impacts of ocean acidification are an urgent issue because of the potential global-scale effects they present across a broad spectrum of marine life.

The absorption of excessive amounts of CO<sub>2</sub> from the atmosphere is changing the chemistry of seawater by increasing the acidity and lowering the seawater's naturally occurring carbonate ion, a building block of the calcium carbonate required of many marine organisms to grow their shells and skeletons. Ocean

- NOAA PMEL & NANOOS worked collectively on content
- Sharing with Pacific Science Center, with links to their planned public displays
- Along with other W Coast RAs, working with shellfish industry

# Coordination at the regional level collaborating with existing programs

- IOOS Regional Associations
- NOAA Natl Climate Service with regional climate director
- NOAA RISA program (Regional Integrated Services)
- NOAA Regional Collaboration Teams
- Dept of Interior regional climate centers & new Landscape Conservation Cooperatives (LCCs)
- Sea Grant Program
- USDA Cooperative Extension Service
- State climatologist
- State coastal management program



*This graphic is an example of a coordinated regional approach to responding to climate change.*

## Evaluations of pCO<sub>2</sub> and pH Sensors

### pCO<sub>2</sub> Analyzer Demonstration in 2010 & 2011

Field tested technologies from Contros, NOAA/PMEL, Pro-Oceanus, Sunburst, YSI in Hood Canal, WA & Kaneohe Bay, HI  
calculations

### pH Sensor Verification planned for 2012

### ACT Symposium and Workshop, Alaska, May 2011:

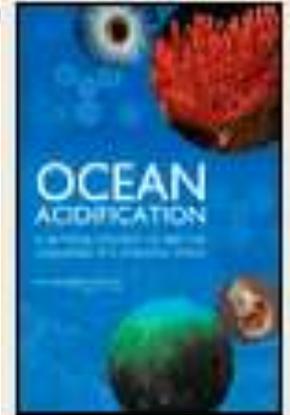
Discussion of technologies to quantify changes to:

- Weather patterns and storm severity
- Biogeochemical cycles and ecosystem processes
- Ocean temperature and acidification
- Sea level rise and coastal erosion
- Sea ice retreat



### Elements of a National OA Observing Network

- Calls for the creation of a National Ocean Acidification Program
- Monitoring program should include: temperature, salinity, oxygen, nutrients, and carbon parameters (DIC,  $p\text{CO}_2$ , total alkalinity, pH).
- Measurements of general indicators of ecosystem change should be supported as part of a program for assessing the effects of acidification.
- NOA Program should review existing and emergent observing networks to identify measurements that could become part of a comprehensive ocean acidification observing network and to identify any critical spatial or temporal gaps in the current capacity to monitor ocean acidification.



### Management and Decision Support

The National Ocean Acidification Program should

- plan for the long-term sustainability of an integrated ocean acidification observation network.
- identify, engage, and respond to stakeholders in its assessment and decision support process and work with existing climate service and marine ecosystem management programs to develop a broad strategy for decision support.

### Data Management

- create and fund a data management office and identify appropriate data center(s) for archiving data or create its own.
- support inter-calibration, standards development, and efforts to make methods of acquiring chemical and biological data clear and consistent.
- support the development of satellite, ship-based, and autonomous sensors as part of a network

# Discussion Questions

- What opportunities do the RAs offer for monitoring the coastal effects of OA?
- How can the OA observing system and the IOOS system complement and not duplicate one another?
- Within each region, are there “hot spots” that should be considered for monitoring?
- What role can the RAs play in addressing other climate needs?