Ocean Acidification Data Visualizations: How to **access** and **use** IOOS data

1. Ocean Acidification
2. How is IOOS data making a difference to shellfish growers?
    - IOOS, Regional Associations
    - Real-time data
    - OA data
3. Real-time data in the context of global issues
4. Developing educational products to aid OA understanding using IOOS data.

Q: Who’s on the line?

- Formal educator
- Informal educator
- Scientist
- Policy/Resource manager
- Interested citizen

Q: Where do you live?

- Atlantic
- Caribbean
- Great Lakes
- Gulf
- Pacific (including Alaska, Hawaii)

OA is
a global condition
with
local effects

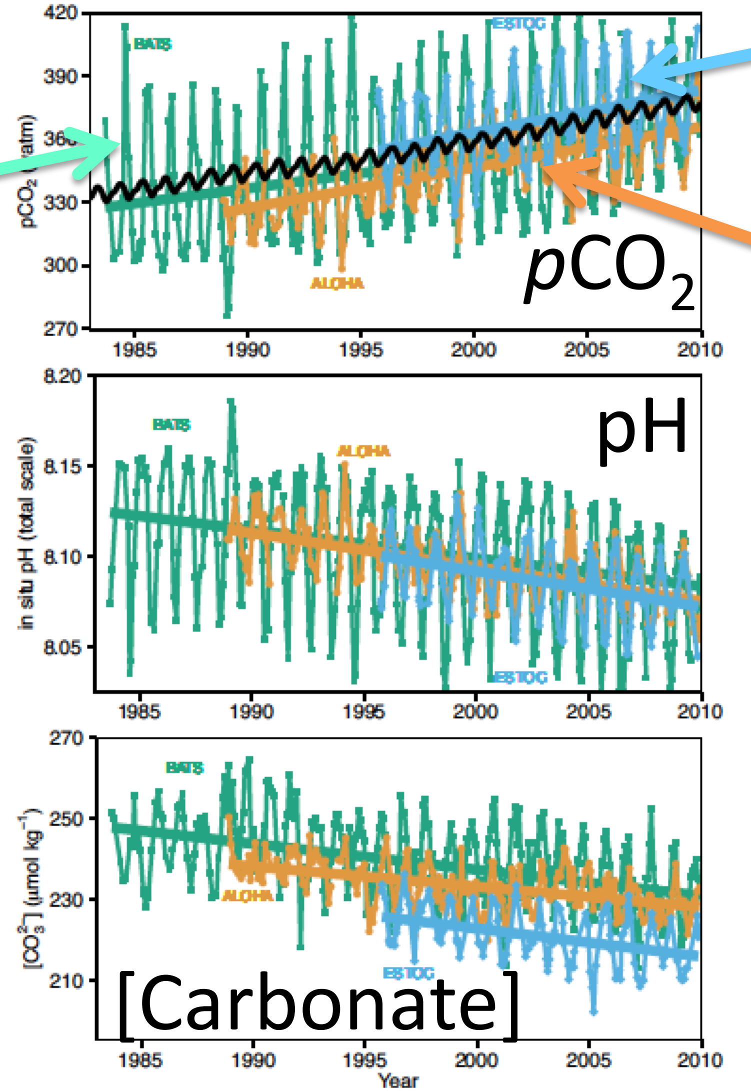
Global condition

OA trend consistent across ocean basins

Bermuda

Canary Is.

Hawaii



Relates to

Ω aragonite

Source: IPCC 2013

Local effects

OA is
a global condition with local effects

- We need local through global scale observations in order to get either correct

- This issue demands **our** coordination, networked skill, and open analysis

U.S. IOOS:
Designed to connect and serve

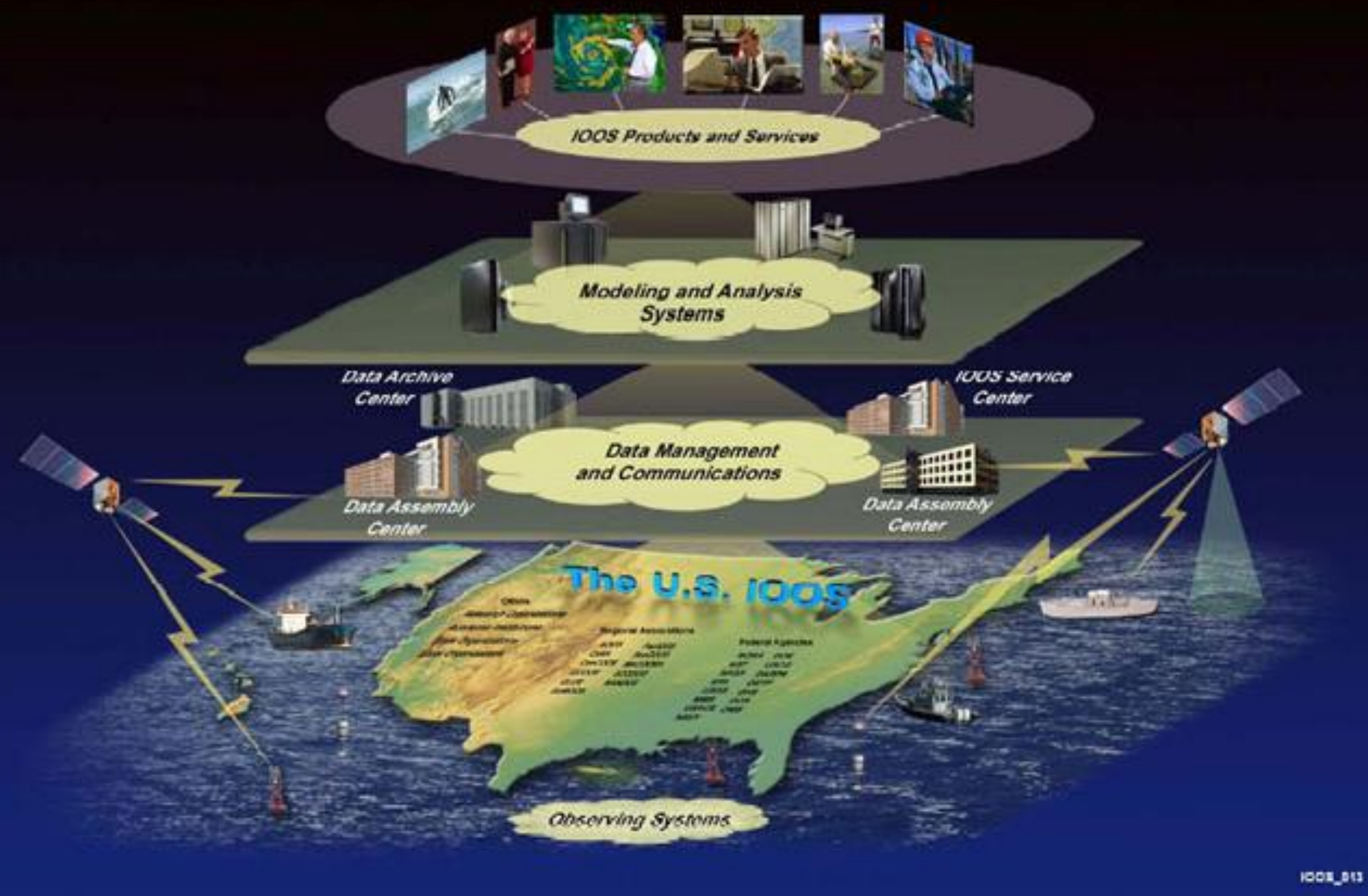
- System to connect **local** to **national** to **global**

- System that is a federal-non federal (aka public-private) partnership
  - Academia, Govt's (fed, tribal, state), Industry, NGO

- System spanning observations-to-decision products, serving coastal ocean data and information

- System to serve the public
  - Climate/weather, marine resources, public health, coastal hazards, marine operations, national security, ecosystem sustainability

IOOS®
INTEGRATED OCEAN OBSERVING SYSTEM



The Federal Partners of IOOS

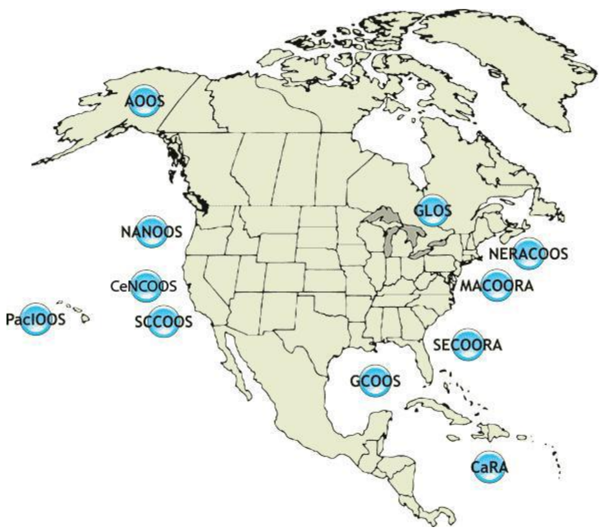
INTEGRATED OCEAN OBSERVING SYSTEM

The Regional Associations of IOOS

INTEGRATED OCEAN OBSERVING SYSTEM

CONSISTENT NATIONAL CAPABILITY

assure



Reg. Assn’ s

Leverage and Link

engage

DIVERSE LOCAL STAKEHOLDERS

IOOS® INTEGRATED OCEAN OBSERVING SYSTEM

NANOOS

'Like putting headlights on a car'

Pacific oysters gain from IOOS® data

Promoting Economic Vitality

About six years ago, production at some Pacific Northwest oyster hatcheries began declining at an alarming rate, posing severe economic impact and challenging a way of life held by shellfish growers for more than 130 years.

By 2008, the oyster harvest at Whiskey Creek, a major Oregon supplier to the majority of West Coast oyster farmers, plummeted 80 percent. At about the same time, corrosive, acidified seawater was hitting the shores of the Pacific.

Something had to be done. Oyster production accounts for more than $84 million of the West Coast shellfish industry, which supports more than 3,000 jobs.

"When you see oyster shells dissolving in water, there's a compelling need to know why," says Bill Dewey of Taylor Shellfish Farms in Washington state.

Thanks to a $500,000 federal investment in monitoring coastal seawater strengthened by data and observational information from the U.S. Integrated Ocean Observing System (IOOS®) and the NOAA Ocean Acidification Program, oyster hatcheries on the verge of collapse just a few years ago are again major contributors to the $111 million West Coast shellfish industry.

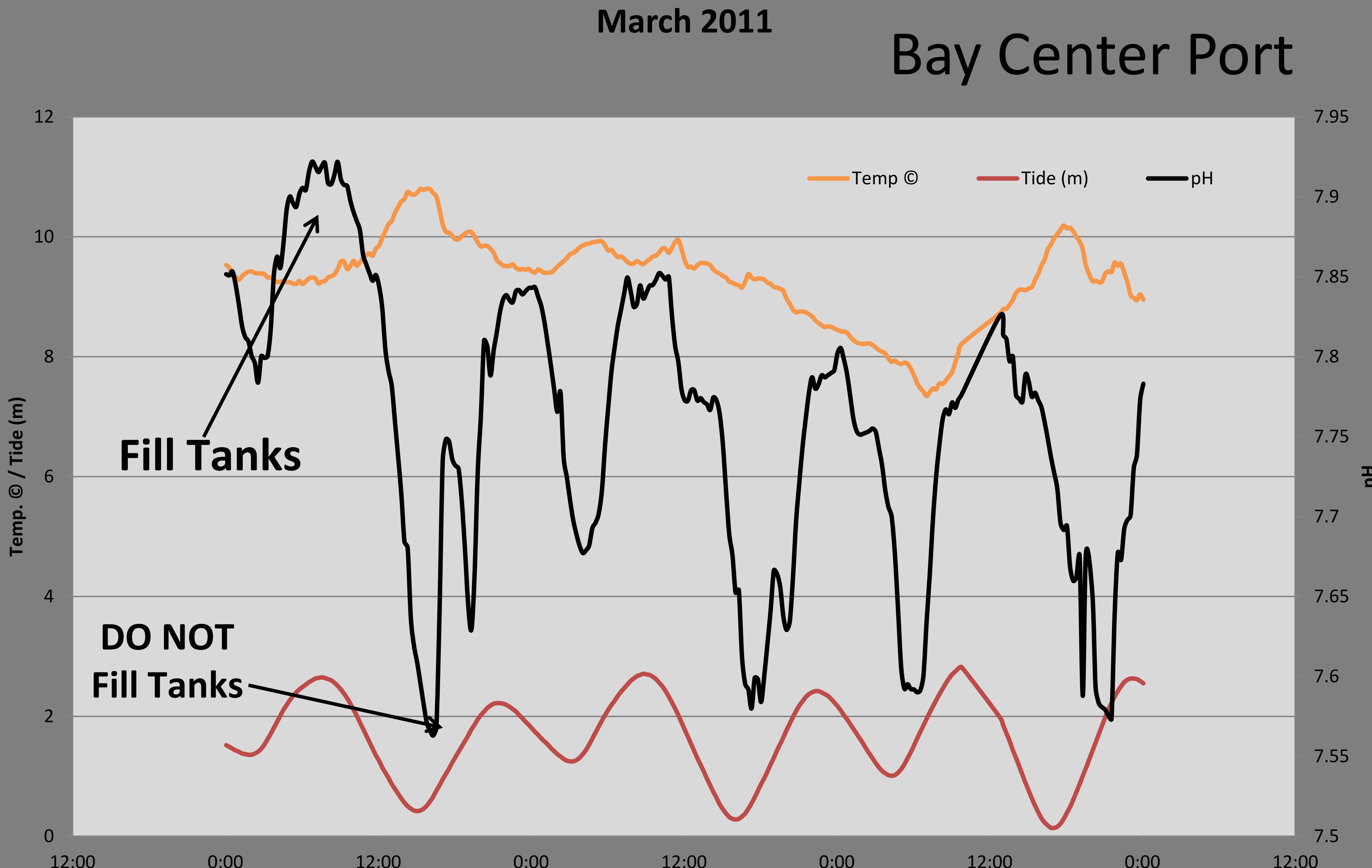
IOOS is a NOAA-led interagency and regional effort aimed at "knowing" — that

IOOS partners in the Northwest Association of Networked Ocean Observing Systems (NANOOS) deployed this buoy in 2010 as part of a three-piece observing array to assess issues in the Northwest, including ocean acidification, hypoxia and harmful algal blooms, and climate change. The coastal buoy will aid computer models that predict ocean and atmospheric conditions. Known as "Chá bă," the buoy is named for the Native American word (pronounced "chay buh") for "whale tail."

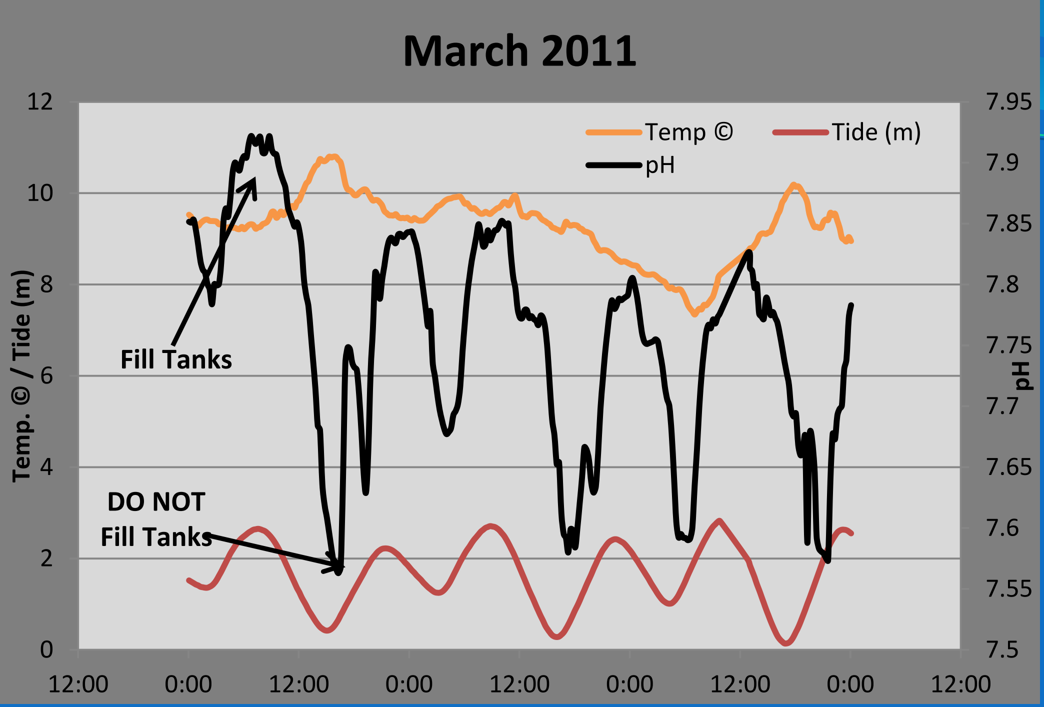
(Photo courtesy of Dr. John Payne, Pacific Ocean Shelf

"Putting an IOOS buoy in the water is like putting headlights on a car. It lets us see changing water conditions in real time," says Mark Wiegardt, co-owner of Whiskey Creek Shellfish Hatchery.

Bay Center Port



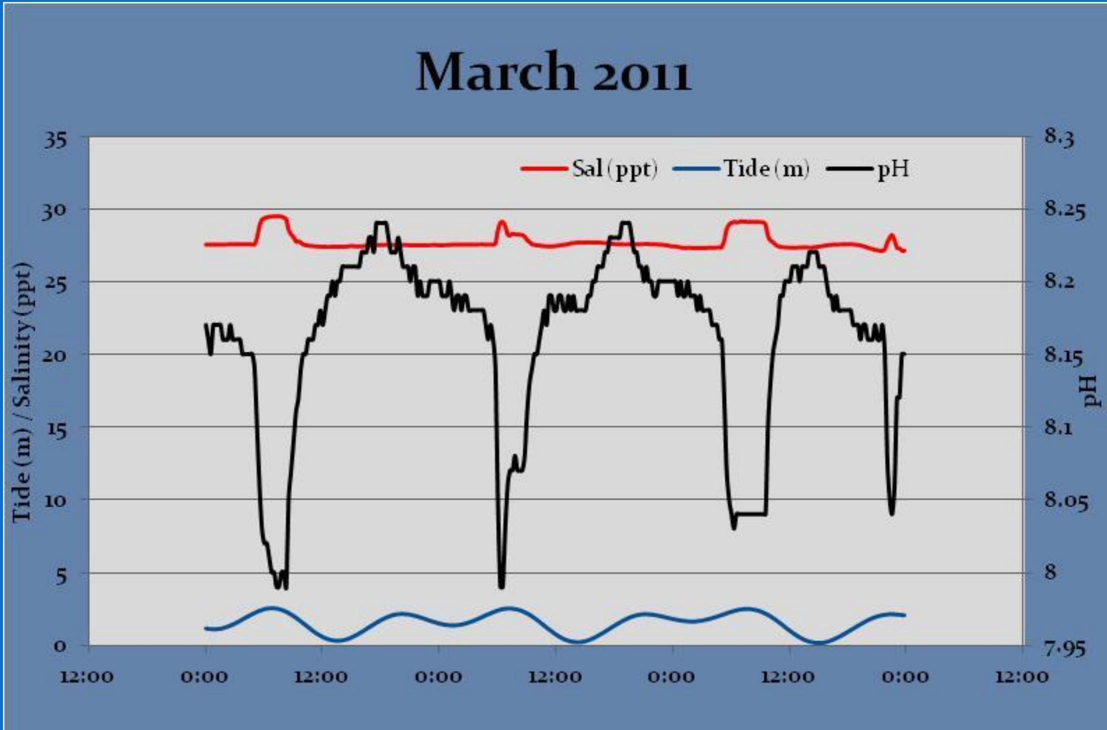
Slide adapted from Andy Suhrbier,
Pacific Shellfish Institute



The pH co-varies with tides, but differently at different places and times

Lummi Pump House

Bay Center Port

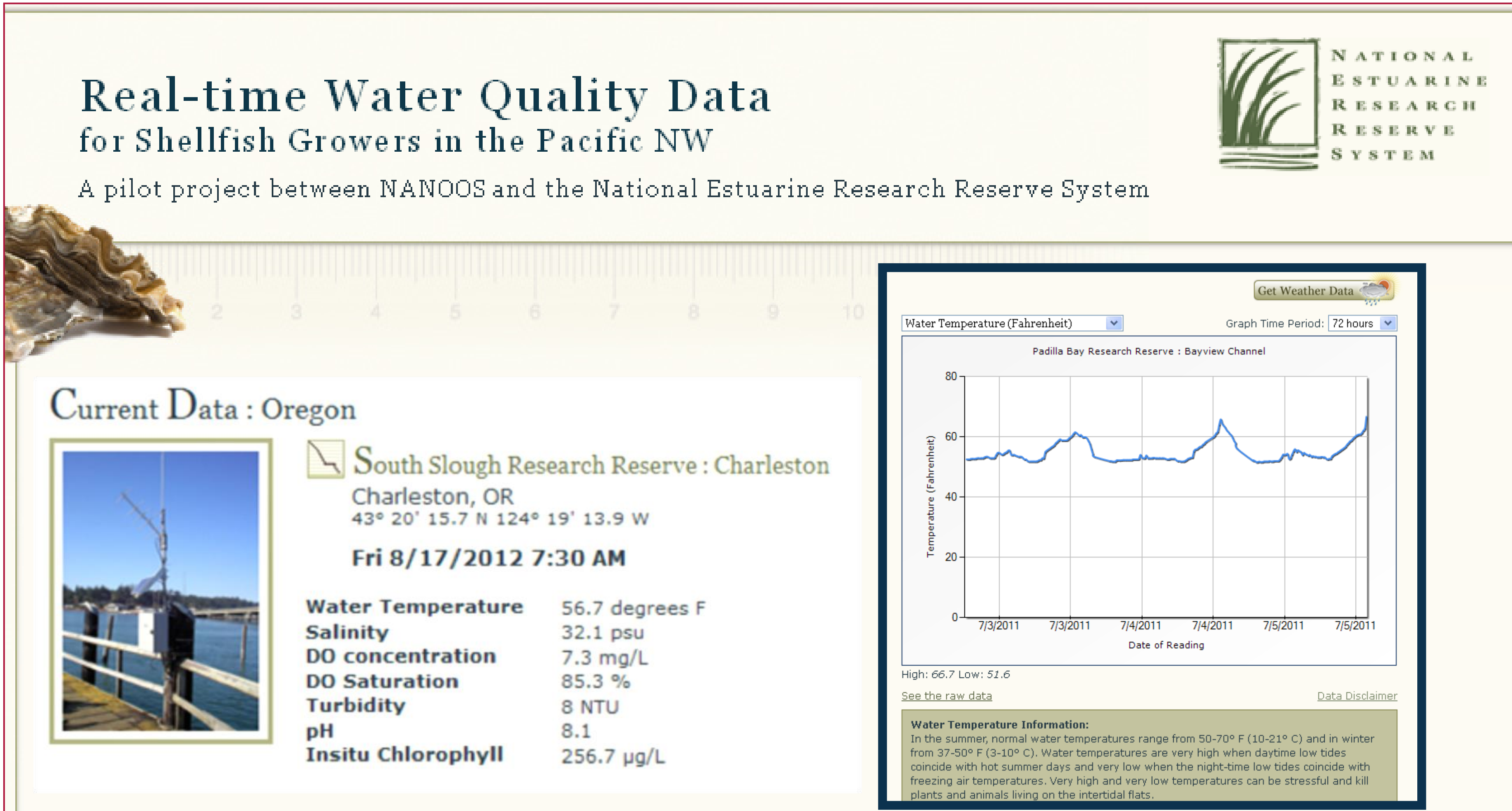


Slide adapted from Andy Suhrbier, PSI

Real-time Water Quality Data
for Shellfish Growers in the Pacific NW

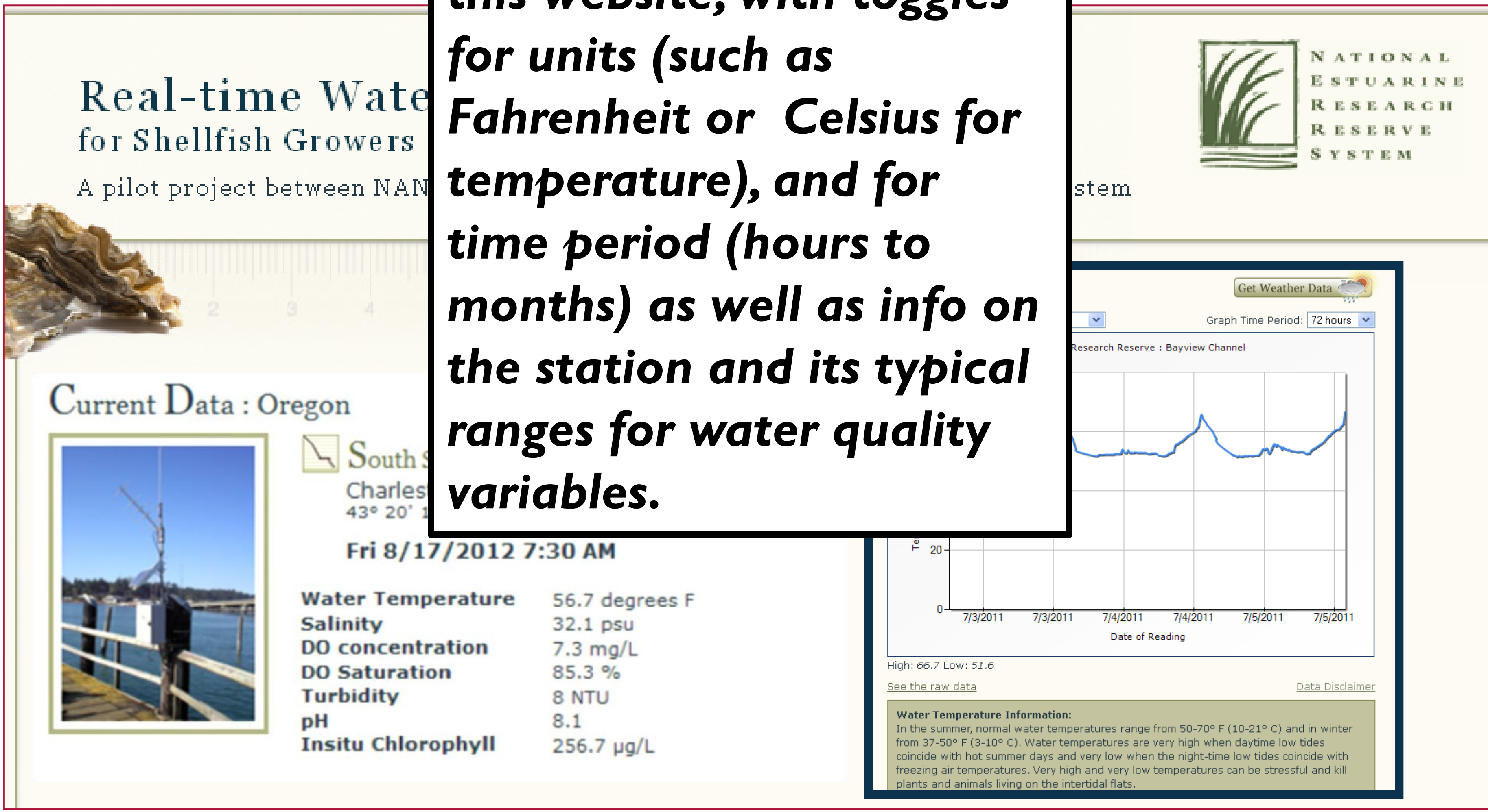
A partnership between the NERRS, NANOOS, and growers since 2004

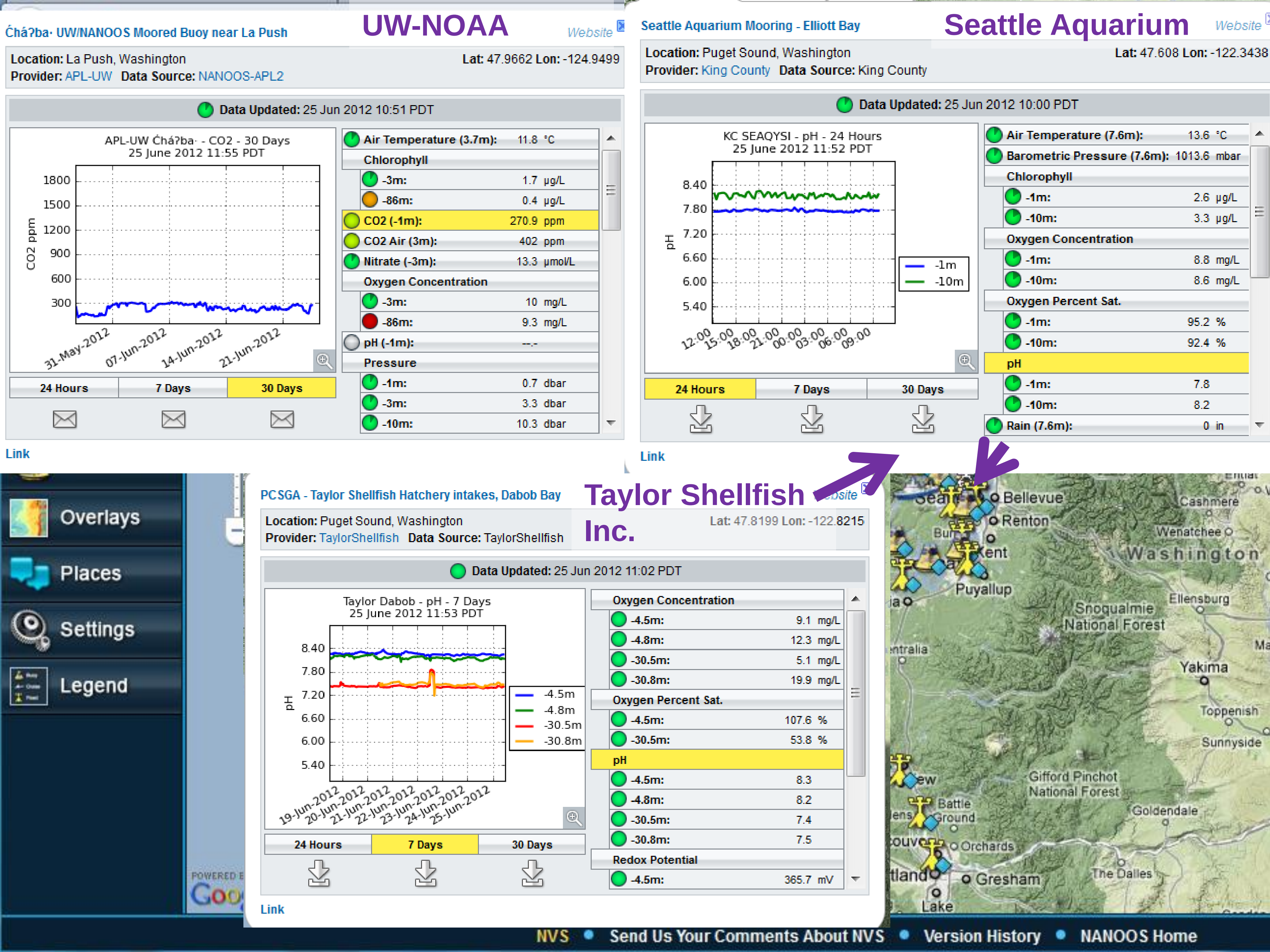
NANOOS and NERRS worked with the Pacific Coast Shellfish Growers to produce REAL-TIME WATER QUALITY DATA access in a web-based application growers designed for 13 stations AK, WA, and OR.



NANOOS and NERRS worked with the Pacific Coast Shellfish Growers to produce REAL-T ccess in a web-based application g s AK, WA, and OR.

Shellfish growers designed this website, with toggles for units (such as Fahrenheit or Celsius for temperature), and for time period (hours to months) as well as info on the station and its typical ranges for water quality variables.




UW-NOAA
Cháʔba· UW/NANOOS Moored Buoy near La Push
Website
Location: La Push, Washington
Lat: 47.9662 Lon: -124.9499
Provider: APL-UW Data Source: NANOOS-APL2
Data Updated: 25 Jun 2012 10:51 PDT
APL-UW Cháʔba· - CO2 - 30 Days
25 June 2012 11:55 PDT
CO2 ppm
1800
1500
1200
900
600
300
31-May-2012
07-Jun-2012
14-Jun-2012
21-Jun-2012
24 Hours
7 Days
30 Days
Air Temperature (3.7m): 11.8 °C
Chlorophyll
-3m: 1.7 µg/L
-86m: 0.4 µg/L
CO2 (-1m): 270.9 ppm
CO2 Air (3m): 402 ppm
Nitrate (-3m): 13.3 µmol/L
Oxygen Concentration
-3m: 10 mg/L
-86m: 9.3 mg/L
pH (-1m): --.-
Pressure
-1m: 0.7 dbar
-3m: 3.3 dbar
-10m: 10.3 dbar
Link
Seattle Aquarium
Seattle Aquarium Mooring - Elliott Bay
Website
Location: Puget Sound, Washington
Lat: 47.608 Lon: -122.3438
Provider: King County Data Source: King County
Data Updated: 25 Jun 2012 10:00 PDT
KC SEAQYSI - pH - 24 Hours
25 June 2012 11:52 PDT
pH
8.40
7.80
7.20
6.60
6.00
5.40
12:00
15:00
18:00
21:00
00:00
03:00
06:00
09:00
-1m
-10m
24 Hours
7 Days
30 Days
Air Temperature (7.6m): 13.6 °C
Barometric Pressure (7.6m): 1013.6 mbar
Chlorophyll
-1m: 2.6 µg/L
-10m: 3.3 µg/L
Oxygen Concentration
-1m: 8.8 mg/L
-10m: 8.6 mg/L
Oxygen Percent Sat.
-1m: 95.2 %
-10m: 92.4 %
pH
-1m: 7.8
-10m: 8.2
Rain (7.6m): 0 in
Link
Taylor Shellfish Inc.
PCSGA - Taylor Shellfish Hatchery intakes, Dabob Bay
Location: Puget Sound, Washington
Lat: 47.8199 Lon: -122.8215
Provider: TaylorShellfish Data Source: TaylorShellfish
Data Updated: 25 Jun 2012 11:02 PDT
Taylor Dabob - pH - 7 Days
25 June 2012 11:53 PDT
pH
8.40
7.80
7.20
6.60
6.00
5.40
19-Jun-2012
20-Jun-2012
21-Jun-2012
22-Jun-2012
23-Jun-2012
24-Jun-2012
25-Jun-2012
-4.5m
-4.8m
-30.5m
-30.8m
24 Hours
7 Days
30 Days
Oxygen Concentration
-4.5m: 9.1 mg/L
-4.8m: 12.3 mg/L
-30.5m: 5.1 mg/L
-30.8m: 19.9 mg/L
Oxygen Percent Sat.
-4.5m: 107.6 %
-30.5m: 53.8 %
pH
-4.5m: 8.3
-4.8m: 8.2
-30.5m: 7.4
-30.8m: 7.5
Redox Potential
-4.5m: 365.7 mV
Link
Overlays
Places
Settings
Legend
Bellevue
Renton
Kent
Puyallup
Cashmere
Wenatchee
Washington
Ellensburg
Snoqualmie National Forest
Yakima
Toppenish
Sunnyside
Gifford Pinchot National Forest
Battle Ground
Goldendale
Orchards
Gresham
The Dalles
Lake
NVS
Send Us Your Comments About NVS
Version History
NANOOS Home

Making it simpler…

NANOOS developed a focus group to work together with shellfish growers to understand their needs and desires for data and information

Lisa Bishop, Little Skookum Shellfish Growers
Bill Dewey, Taylor Shellfish
Paul Harris, Seattle Shellfish
Eric Sparkman, Squaxin Island Tribe
Dave Steele, Rock Point Oyster
Shina Wysocki, Chelsea Farms
Amy Sprenger, NANOOS Education
Sarah Mikulak, NANOOS Outreach
Troy Tanner, NANOOS Web Developer
Jan Newton, NANOOS Director


mukooks 83


mukooks 83
nvs.nanoos.org
nvs2.nanoos.org


EXIT

What resulted…

A new NVS Shellfish Growers app with:

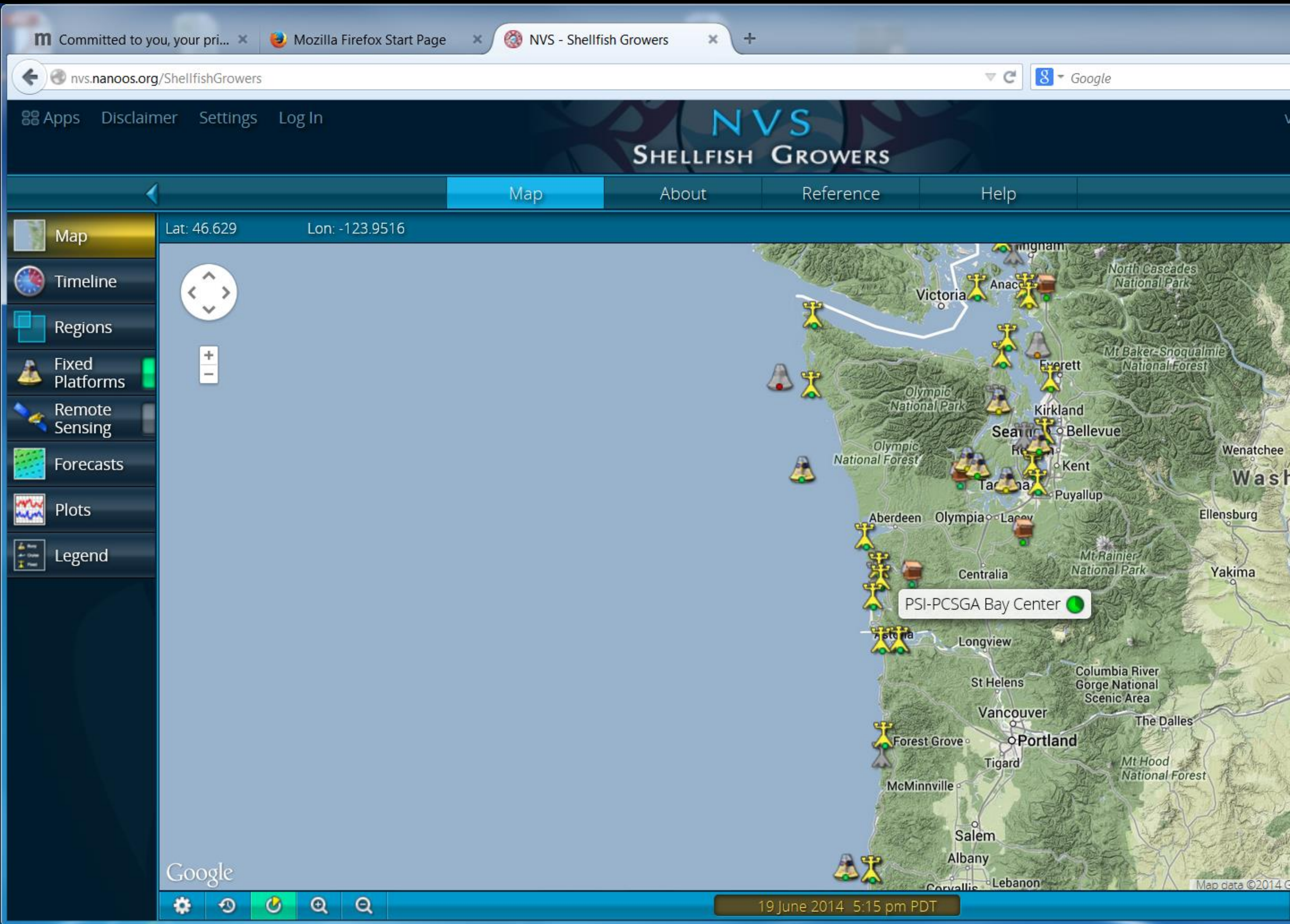
- Expanded tidal forecast data to more sites
- Graphs for comparing multiple variables
- A "Help" tab for how to use the app's features
- River gauge data
- Reference information on variables
- Ability to download >one variable at a time

And future plans to have:

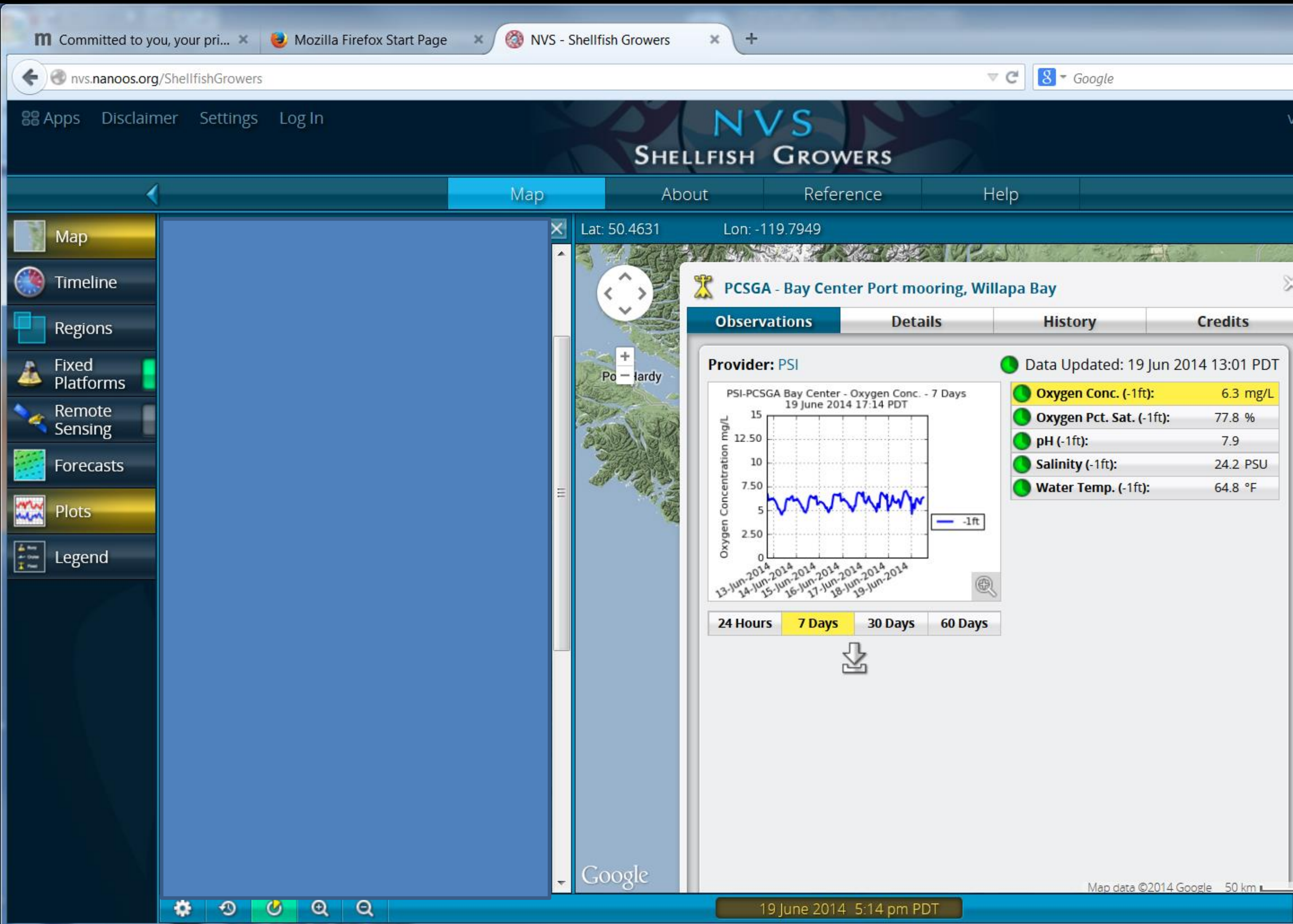
- Airport weather data, precipitation
- Make a notifications feature
- Compare present data with historical data

What resulted…

http://nvs.nanoos.org/



Committed to you, your pri...
Mozilla Firefox Start Page
NVS - Shellfish Growers
nvs.nanoos.org/ShellfishGrowers
Google
Apps
Disclaimer
Settings
Log In
NVS
SHELLFISH GROWERS
Map
About
Reference
Help
Map
Timeline
Regions
Fixed Platforms
Remote Sensing
Forecasts
Plots
Legend
Lat: 46.629
Lon: -123.9516
Victoria
North Cascades National Park
Mt Baker-Snoqualmie National Forest
Everett
Olympic National Park
Kirkland
Bellevue
Olympic National Forest
Kent
Wenatchee
Puyallup
Aberdeen
Olympia
Ellensburg
Mt Rainier National Park
Centralia
Yakima
PSI-PCSGA Bay Center
Longview
St Helens
Columbia River Gorge National Scenic Area
Vancouver
The Dalles
Forest Grove
Portland
Tigard
Mt Hood National Forest
McMinnville
Salem
Albany
Lebanon
Google
19 June 2014 5:15 pm PDT


Committed to you, your pri...
Mozilla Firefox Start Page
NVS - Shellfish Growers
nvs.nanoos.org/ShellfishGrowers
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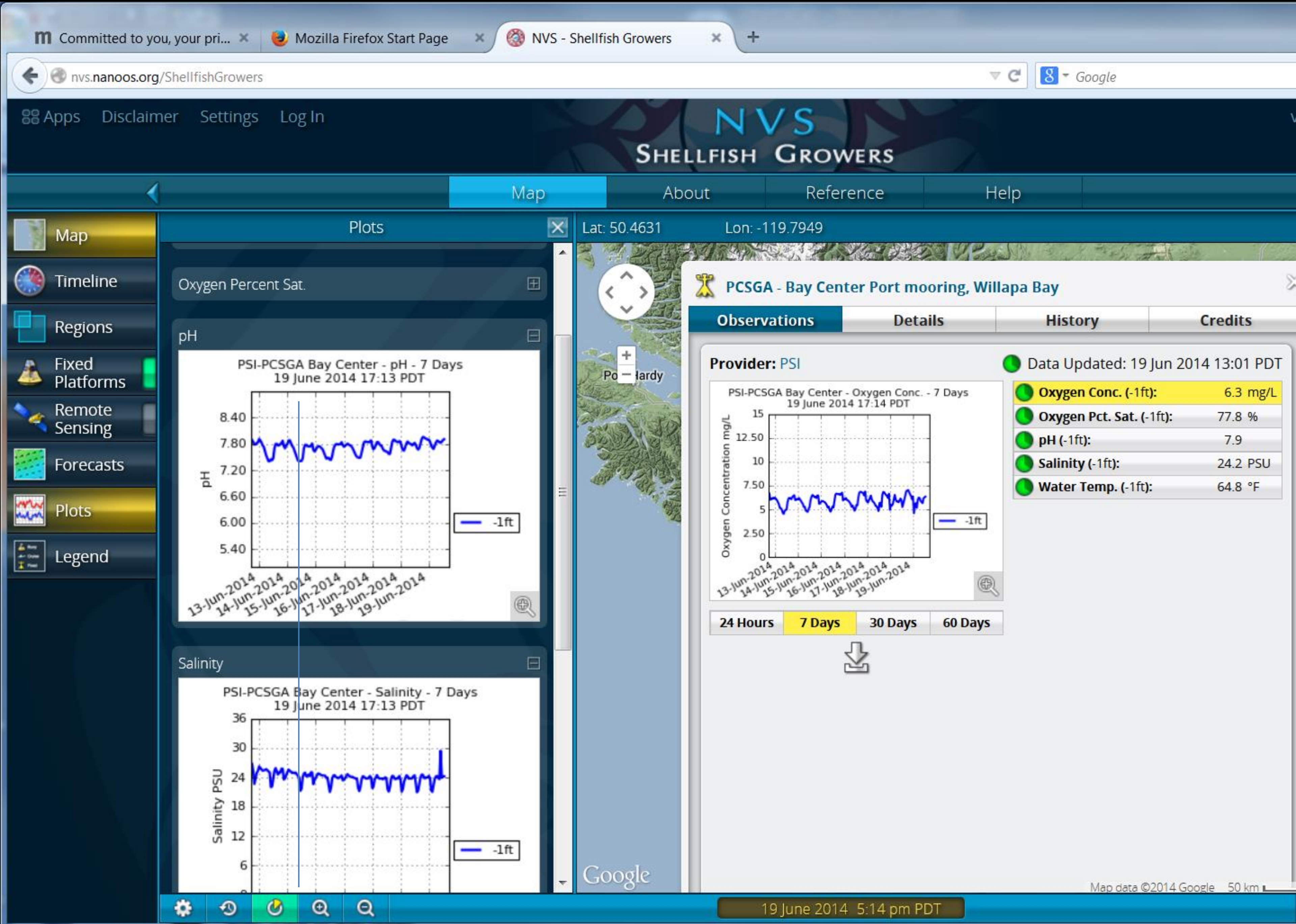
Apps
Disclaimer
Settings
Log In
NVS
SHELLFISH GROWERS
Map
About
Reference
Help
Map
Timeline
Regions
Fixed Platforms
Remote Sensing
Forecasts
Plots
Legend
Lat: 50.4631
Lon: -119.7949
PCSGA - Bay Center Port mooring, Willapa Bay
Observations
Details
History
Credits
Provider: PSI
Data Updated: 19 Jun 2014 13:01 PDT
PSI-PCSGA Bay Center - Oxygen Conc. - 7 Days
19 June 2014 17:14 PDT
Oxygen Concentration mg/L
15
12.50
10
7.50
5
2.50
0
-1ft
13-Jun-2014
14-Jun-2014
15-Jun-2014
16-Jun-2014
17-Jun-2014
18-Jun-2014
19-Jun-2014
Oxygen Conc. (-1ft): 6.3 mg/L
Oxygen Pct. Sat. (-1ft): 77.8 %
pH (-1ft): 7.9
Salinity (-1ft): 24.2 PSU
Water Temp. (-1ft): 64.8 °F
24 Hours
7 Days
30 Days
60 Days
Google
Map data ©2014 Google
50 km
19 June 2014 5:14 pm PDT


Committed to you, your pri...
Mozilla Firefox Start Page
NVS - Shellfish Growers
nvs.nanoos.org/ShellfishGrowers
Google
Apps
Disclaimer
Settings
Log In
NVS
Shellfish Growers
Map
About
Reference
Help
Map
Timeline
Regions
Fixed Platforms
Remote Sensing
Forecasts
Plots
Legend
Plots
Oxygen Percent Sat.
pH
PSI-PCSGA Bay Center - pH - 7 Days
19 June 2014 17:13 PDT
pH
8.40
7.80
7.20
6.60
6.00
5.40
-1ft
13-Jun-2014
14-Jun-2014
15-Jun-2014
16-Jun-2014
17-Jun-2014
18-Jun-2014
19-Jun-2014
Salinity
PSI-PCSGA Bay Center - Salinity - 7 Days
19 June 2014 17:13 PDT
Salinity PSU
36
30
24
18
12
6
-1ft
Lat: 50.4631
Lon: -119.7949
PCSGA - Bay Center Port mooring, Willapa Bay
Observations
Details
History
Credits
Provider: PSI
Data Updated: 19 Jun 2014 13:01 PDT
PSI-PCSGA Bay Center - Oxygen Conc. - 7 Days
19 June 2014 17:14 PDT
Oxygen Concentration mg/L
15
12.50
10
7.50
5
2.50
0
-1ft
13-Jun-2014
14-Jun-2014
15-Jun-2014
16-Jun-2014
17-Jun-2014
18-Jun-2014
19-Jun-2014
Oxygen Conc. (-1ft): 6.3 mg/L
Oxygen Pct. Sat. (-1ft): 77.8 %
pH (-1ft): 7.9
Salinity (-1ft): 24.2 PSU
Water Temp. (-1ft): 64.8 °F
24 Hours
7 Days
30 Days
60 Days
Google
Map data ©2014 Google
50 km
19 June 2014 5:14 pm PDT

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

IOOS® INTEGRATED OCEAN OBSERVING SYSTEM

'Like putting headlights on a car'

Pacific oysters gain from IOOS® data

Promoting Economic Vitality

About six years ago, production at some Pacific Northwest oyster hatcheries began declining at an alarming rate, posing severe economic impact and challenging a way of life held by shellfish growers for more than 130 years.

By 2008, the oyster harvest at Whiskey Creek, a major Oregon supplier to the majority of West Coast oyster farmers, plummeted 80 percent. At about the same time, corrosive, acidified seawater was hitting the shores of the Pacific.

Something had to be done. Oyster production accounts for more than $84 million of the West Coast shellfish industry, which supports more than 3,000 jobs.

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Thanks to a $500,000 federal investment in monitoring coastal seawater strengthened by data and observational information from the U.S. Integrated Ocean Observing System (IOOS®) and the NOAA Ocean Acidification Program, oyster hatcheries on the verge of collapse just a few years ago are again major contributors to the $111 million West Coast shellfish industry.

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(Photo courtesy of Dr. John Payne, Pacific Ocean Shelf

Enabling Partnerships:

Shellfish growers and OA data

IOOS is providing information having real <u>impact</u> to regional stakeholders

Makes connections

The **West Coast Ocean Observing Systems** (SCCOOS, CeNCOOS and NANOOS) and the **West Coast Governors Alliance on Ocean Health** (WCGA) signed a Memorandum of Understanding in October 2012 to advance the effective management of coastal and ocean resources on the West Coast, ensuring that the organizations' collaborative efforts are responsive to the comprehensive West Coast stakeholder community and incorporate the best available ocean observation-based information.

Sea Grant Fellow Laura Lilly

- Ocean Acidification
- Marine Debris

West Coast Ocean Acidification Asset Inventory

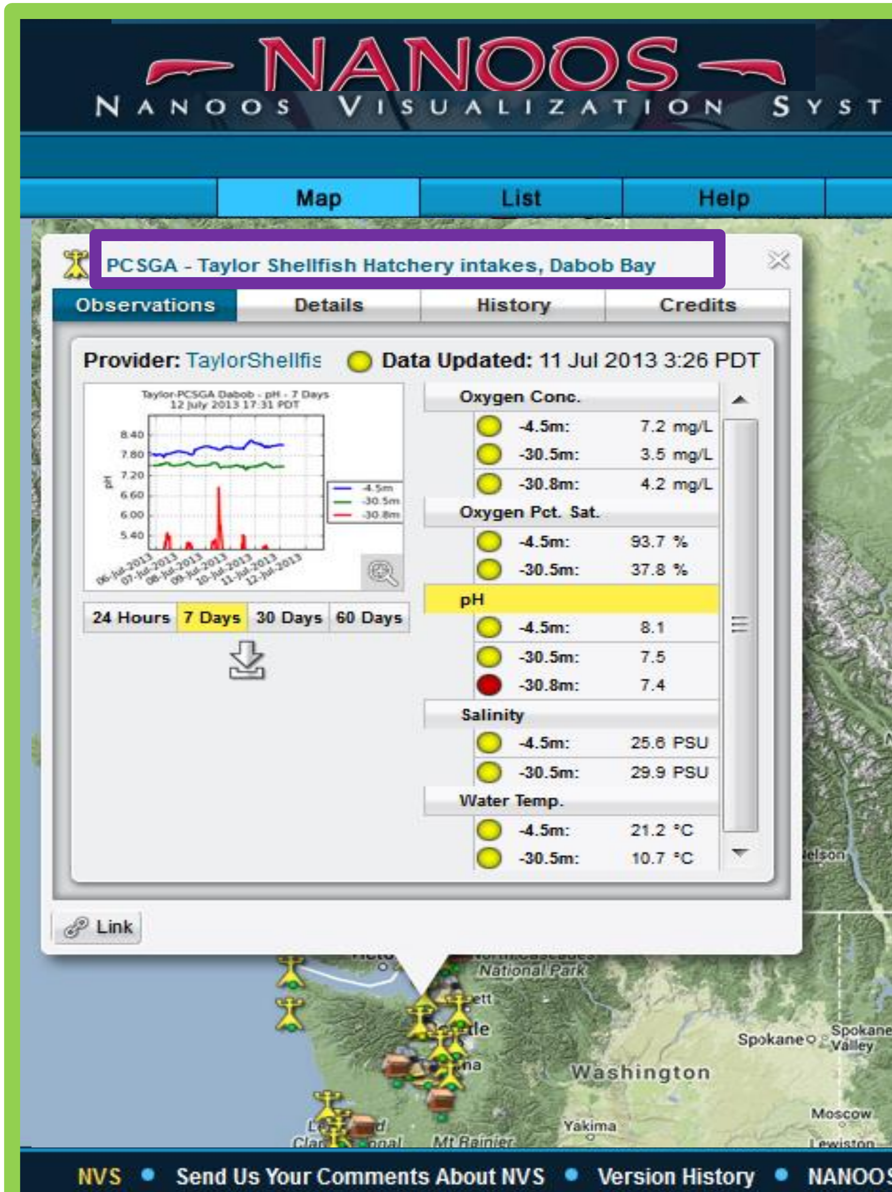
Measurements

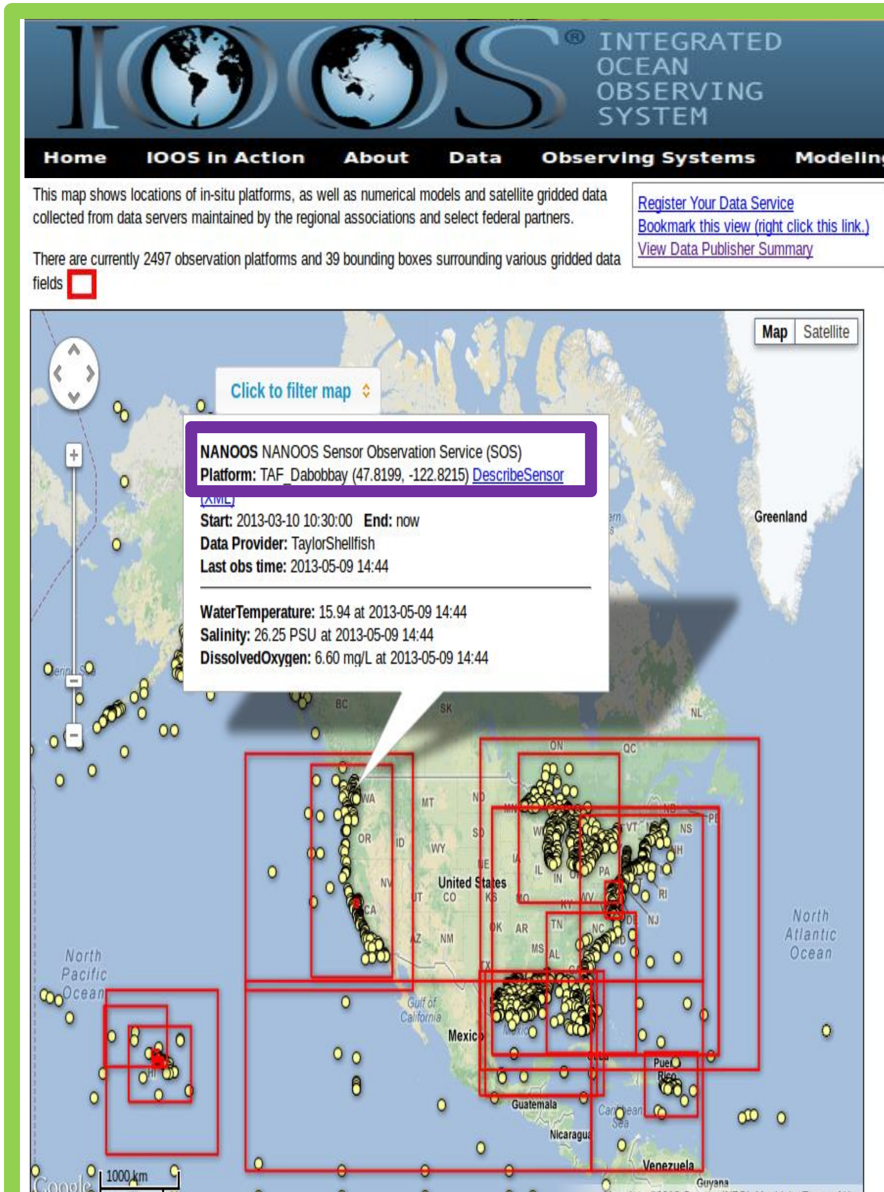
1) Direct OA variables (pCO_2, pH, DIC, TA)
2) Proxy variables (T, S, O)
   - tracks aragonite saturation state (Ω)

Includes data from:
buoys, fixed platforms, cruises, and gliders.

Makes data available

OA data accessible via regional portals AND discoverable nationally via IOOS





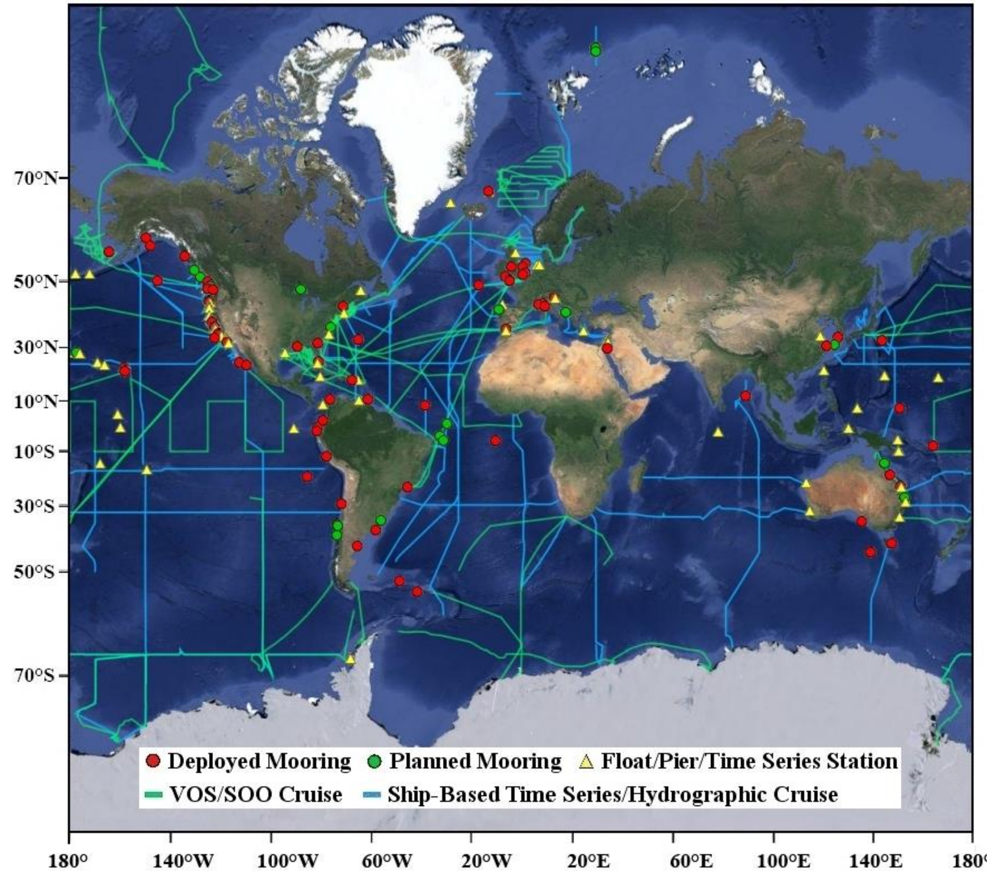
Global scale

GOA-ON
Global Ocean Acidification Observing Network

Goal 1 Global OA conditions

Goal 2 Ecosystem response to OA

Goal 3 Data to optimize modeling for OA



Regional scale

IOOS INTEGRATED OCEAN OBSERVING SYSTEM

AOOS Alaska Ocean Observing System

THE EYE ON ALASKA'S COASTS AND OCEANS

Ocean Acidification

Our oceans are growing more acidic

Scientists estimate that that the ocean is 25% more acidic today than it was 300 years ago, traceable to increasing levels of atmospheric CO_2 from fossil fuel combustion and land use change.

Almost half of anthropogenic CO_2 remains in the atmosphere, but the ocean absorbs most of the rest, lowering pH and thus increasing in acidity. Alaska waters are in an especially tough spot because of their unique circulation patterns and colder temperatures —cold water can absorb more CO_2 than warm water. Visit our Frequently Asked Questions page to learn more about ocean acidification.

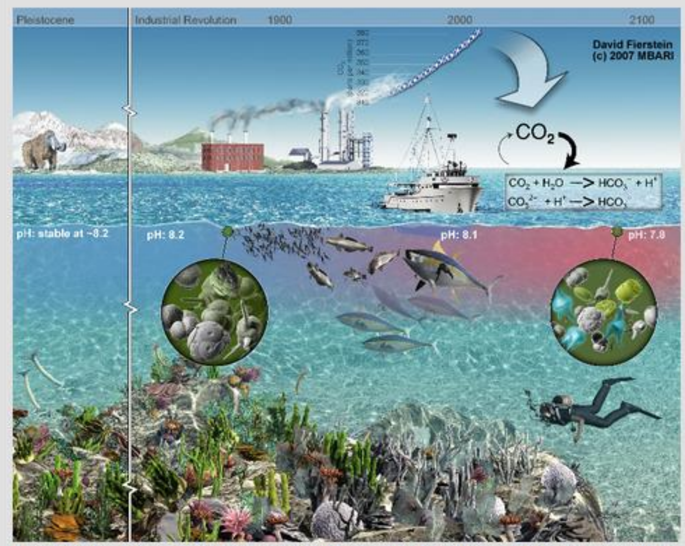


Illustration of the principles involved in ocean acidification. David Fierstein © 2007 MBARI

Observing acidification in the Arctic

Scientists and managers can better prepare Alaskans for potential impacts to fisheries and livelihoods by learning more about how the ocean absorbs CO_2 and other gases. AOOS is committed to working with a coalition of partners to fund, deploy and maintain

Regional scale

IOOS INTEGRATED OCEAN OBSERVING SYSTEM

SCCOOS

Southern California Coastal Ocean Observing System

ABOUT DATA, PRODUCTS and MODELING PROJECTS CLASSROOM USERS HOME

PROJECTS

SCCOOS Projects
- 2012 Ocean Acidification
- 2012 OCSD Outfall Repair & Diversion
- Moorings
- 2011 Tsunami
- Cardiff Beach Erosion & Inundation Project
- 2010 Central Bight Water Quality '08
- 2007 Southern California Fires
- 2006 Hyperion Outfall Diversion
- 2006 Huntington Beach (HB06) Experiment
- NAVAIR
- Marine Mammal Health

2012 Ocean Acidification
- Overview
- Spray Underwater Gliders

2012 OCEAN ACIDIFICATION

OCEAN ACIDIFICATION

What is ocean acidification?

As the ocean absorbs increasing levels of carbon dioxide (CO2) from the atmosphere, it causes changes in ocean chemistry. When carbon dioxide reacts with water, it creates carbonic acid, decreasing pH and carbonate ion concentration. Lower levels of pH in the ocean result in higher levels of acidity, causing "ocean acidification."

Click here to view Part 1 and Part 2 of Scripps Institution of Oceanography Professor Andrew Dickson's "Introduction to CO2 Chemistry in Seawater" lecture on UCTV.

What are the potential impacts?

Ocean acidification can have significant impacts on marine species, especially organisms that rely on calcium carbonate to build and maintain their shells and skeletons, such as clams, oysters, sea urchins, crabs, lobsters, and corals. Ocean acidification can both reduce amounts of calcium carbonate and prove corrosive to shells and corals.

What is SCCOOS doing?

Makes information available

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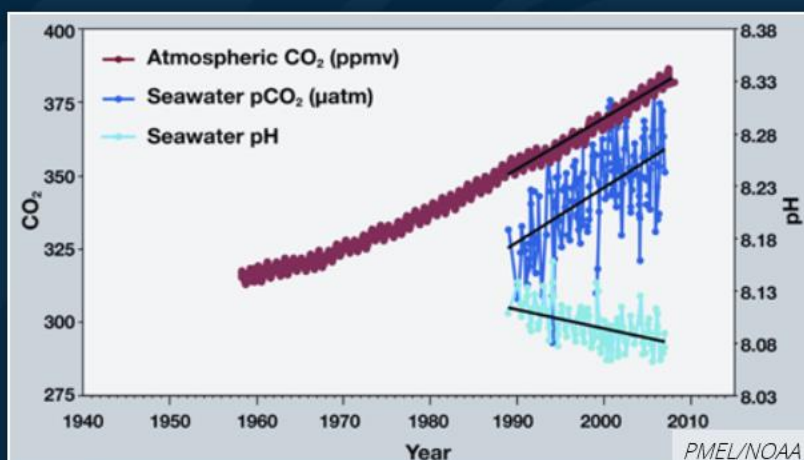
Ocean Acidification

What is Ocean Acidification?

Ocean acidification refers to the ongoing change in the chemistry of the ocean caused primarily by the ocean's absorption of carbon dioxide from the atmosphere. For the last 250 years, the burning of fossil fuels — coal, oil, natural gas — for energy, cement production, and deforestation has been pumping carbon dioxide or CO_2, into the atmosphere. The ocean absorbs about 1/4 of this excess CO_2 released into the atmosphere every year. This addition of CO_2 into the ocean is changing the chemistry of seawater by increasing the acidity and lowering the seawater's naturally occurring carbonate ion. CO_2, when combined with water, forms a weak acid, which increases the hydrogen ion concentration in the ocean, lowering the pH and making the oceans less alkaline or more acidic. As the ocean becomes less alkaline there is a reduction in the amount of carbonate ions and calcium carbonate minerals, biologically important building blocks for many marine organisms.



Additional Resources

20 Facts About Ocean Acidification
PDF

NOAA Pacific Marine Environmental Lab Carbon Program
Information Page

NOAA Ocean Acidification Program
Information Page

NOAA Northwest Fisheries Science Center
Information Page

Washington State Blue Ribbon Panel on Ocean Acidification
Information Page
PDF

Scientific Summary of Ocean Acidification in Washington State Marine Waters
PDF

West Coast Ocean Acidification and Hypoxia Science Panel
Information Page

California Current Acidification Network (C-CAN)
Information Page

Ocean Acidification Around the World
An interactive tool designed to make ocean acidification understandable by tracking emerging science and providing updates on what is occurring and where.
Information Page

Makes information available

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NVS
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Mobile Apps

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Resources

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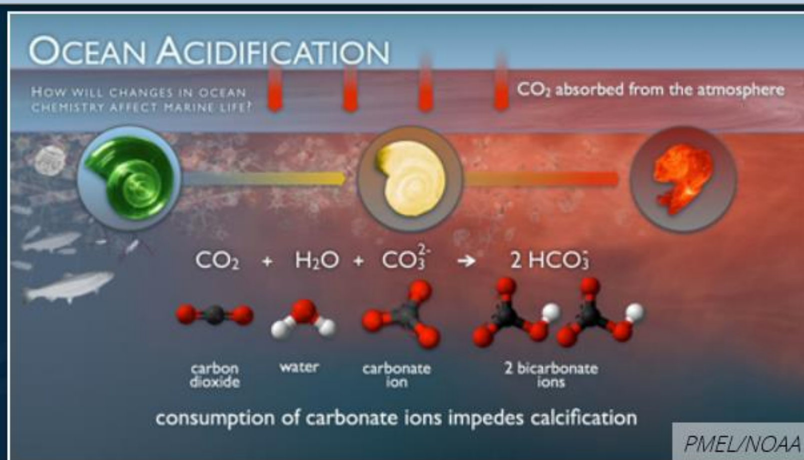


The absorption of excessive amounts of CO_2 from the atmosphere is changing the chemistry of seawater by increasing the acidity and lowering the seawater's naturally occurring carbonate ion, a building block of the calcium carbonate required of many marine organisms to grow their shells and skeletons. Ocean acidification reduces calcification rates in shell-forming organisms such as corals and shellfish. In coastal areas with coral reefs, reef structures impacted by ocean acidification are weaker and less able to protect coastal communities from storm damage. Economically important shellfish species such as oysters, scallops, mussels, and clams are negatively impacted by reduced calcification rates brought on by ocean acidification, particularly in larval stages shell building. Other calcifying organisms like tiny sea snails known as pteropods are affected by the chemistry changes. Shelled pteropods are a critical food source for salmon, mackerel, herring, cod, and even whales.

Ocean Acidification in the Pacific Northwest

The marine waters of the Pacific Northwest are particularly vulnerable to ocean acidification. Regional marine processes including coastal upwelling exacerbate the acidifying effects of global carbon dioxide emissions. Coastal upwelling brings deep ocean water, which is rich in carbon dioxide and low in

View in NVS

Related Videos

NOAA IOOS Video on Ocean Acidification
Video Page

Washington Ocean Acidification Center
University of Washington Applied Physics Laboratory Video on the Washington Ocean Acidification Center and NANOOS
Video Page

Acidity on the Halfshell
A five minute presentation by Libby Jewett of NOAA OAP.
Video Page

Ocean Acidification in Puget Sound
Produced by students from the Suquamish Tribal Early College High School.
Video Page

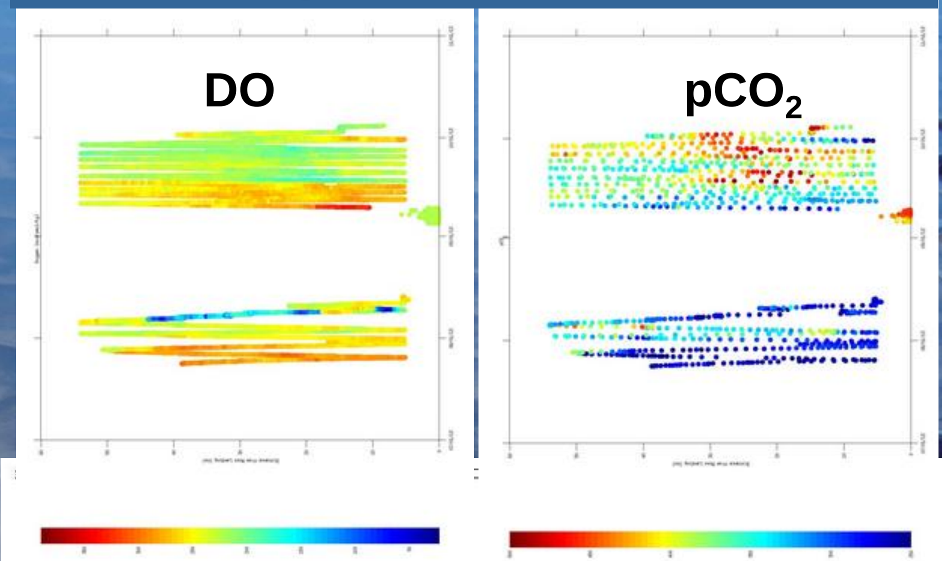
The Other CO_2 Problem
Animation video by Ridgeway School students, Plymouth, UK.
Video Page

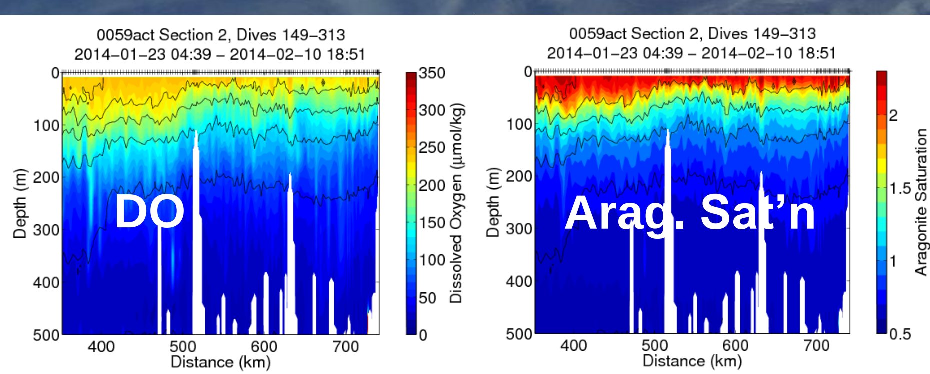
Tracking an Ocean of Carbon
Narrated by Dr. Chris Sabine.
Video Page

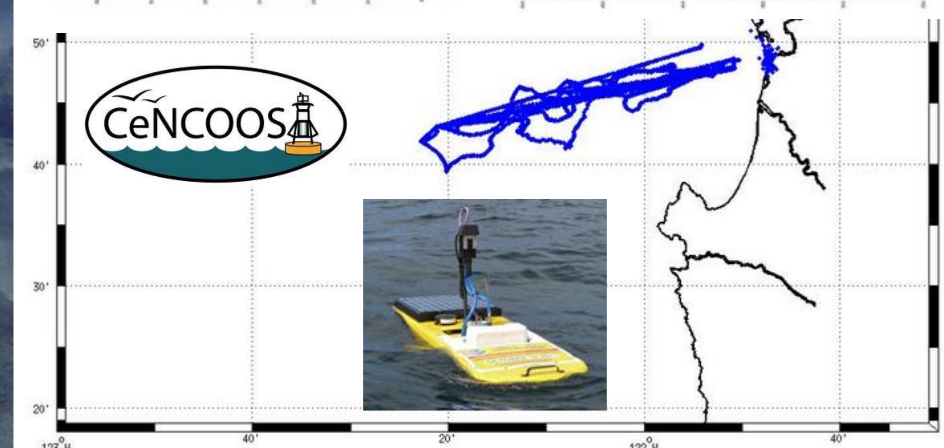
Acid Ocean
A short BBC Newsnight film on the impact of CO_2 on the Ocean.
Video Page

Makes OA technology investments

CeNCOOS & SCCOOS support gliders collecting pH, oxygen, pCO_2 and data to estimate aragonite saturation state.

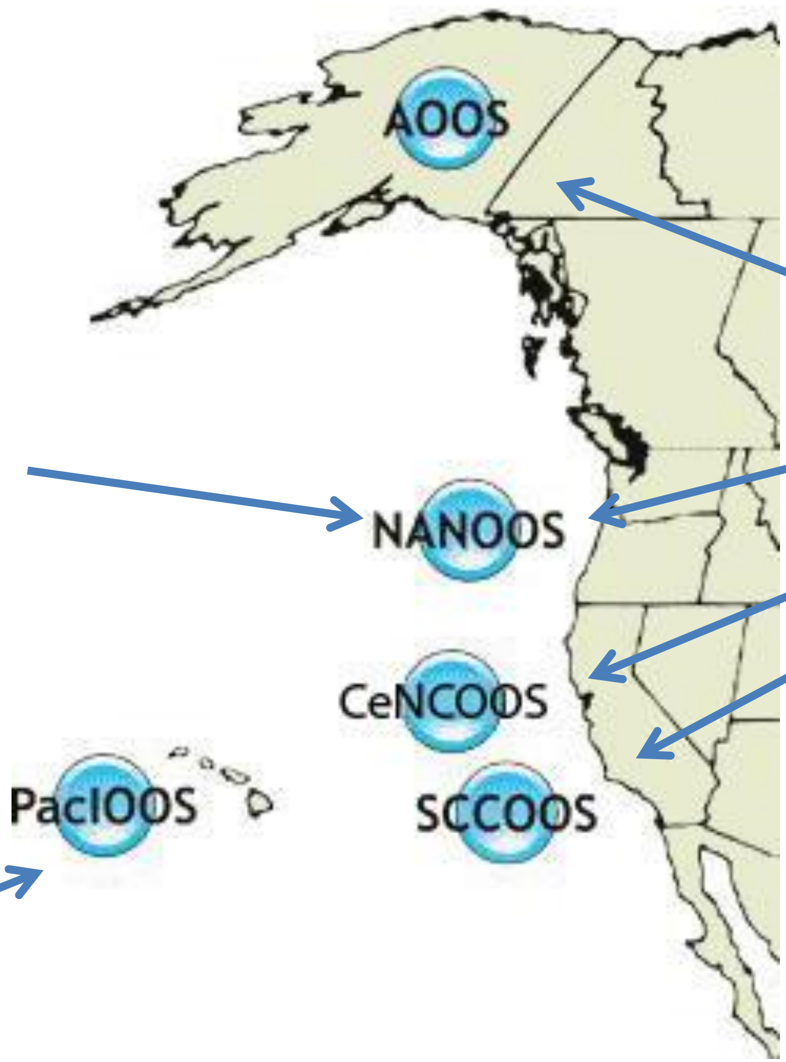






Makes OA technology investments

Estuarine OA profiling buoys, field testing pH at depth



Shellfish hatchery monitoring with expert consultants and joint data delivery

Field testing DIC sensor

Apps Settings

IOOS Pacific Region Ocean Acidification

Explorer

Welcome to the IOOS Pacific Region Ocean Acidification Data Portal

Ocean acidification refers to the change in the chemistry of seawater caused primarily by the ocean's absorption of carbon dioxide from the atmosphere.

From our data explorer, you can find data relevant to ocean acidification from partners in the Pacific region. This portal was funded by U.S. IOOS, with data streams contributed by regional IOOS observing systems in Alaska (AOOS), Washington and Oregon (NANOOS), Central and Northern California (CeNCOOS), Southern California (SCCOOS), and the Pacific Islands (PacIOOS) as well as through NOAA's Ocean Acidification Program (OAP) and Pacific Marine Environmental Laboratory (PMEL). Data presented here were funded though NOAA OAP, U.S. IOOS, or regional observing system collaborators. For further information about ocean acidification, follow these national and regional links, which include FAQs and videos on the basic understanding of and consequences from ocean acidification, as well as links to information on sensors (Alliance for Coastal Technologies, ACT) and practices (California Current Acidification Network, C-CAN) used to monitor ocean acidification status.

The seawater chemistry changes from ocean acidification affect the ecology and economy of marine communities, and this is projected to grow with time. We can better prepare for potential impacts to marine communities, fisheries, and livelihoods by learning more about how the ocean absorbs carbon dioxide. IOOS is committed to working with a diversity of partners to provide data about ocean acidification conditions.

AOOS Alaska Ocean Observing System | NANOOS | CeNCOOS | Southern California Coastal Ocean Observing System | PacIOOS Pacific Islands Ocean Observing System | IOOS Integrated Ocean Observing System | OAP NOAA Ocean Acidification Program | PMEL | Alliance for Coastal Technologies | C-CAN California Current Acidification Network

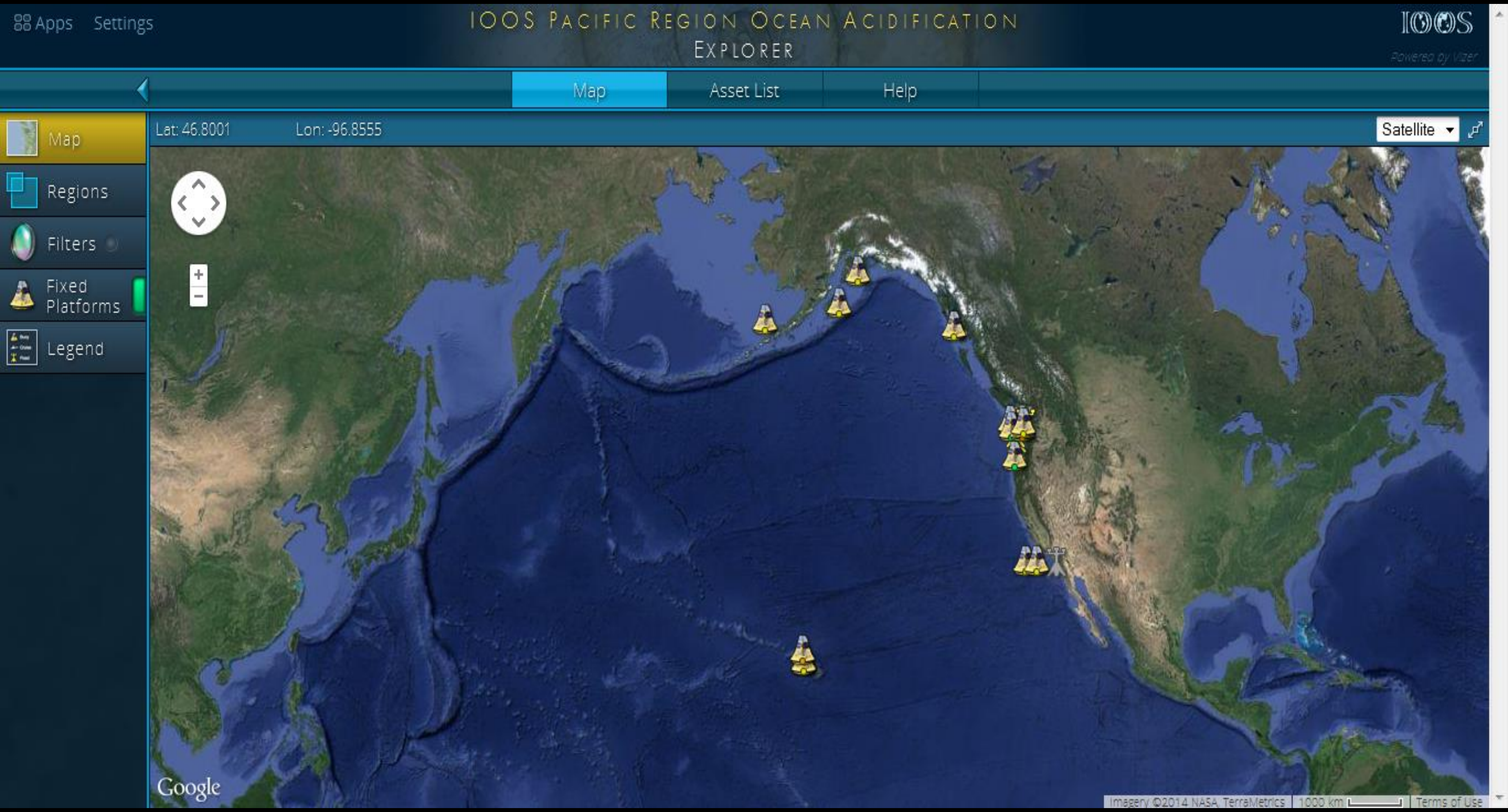
Additions & Updates

View Last 3 Months

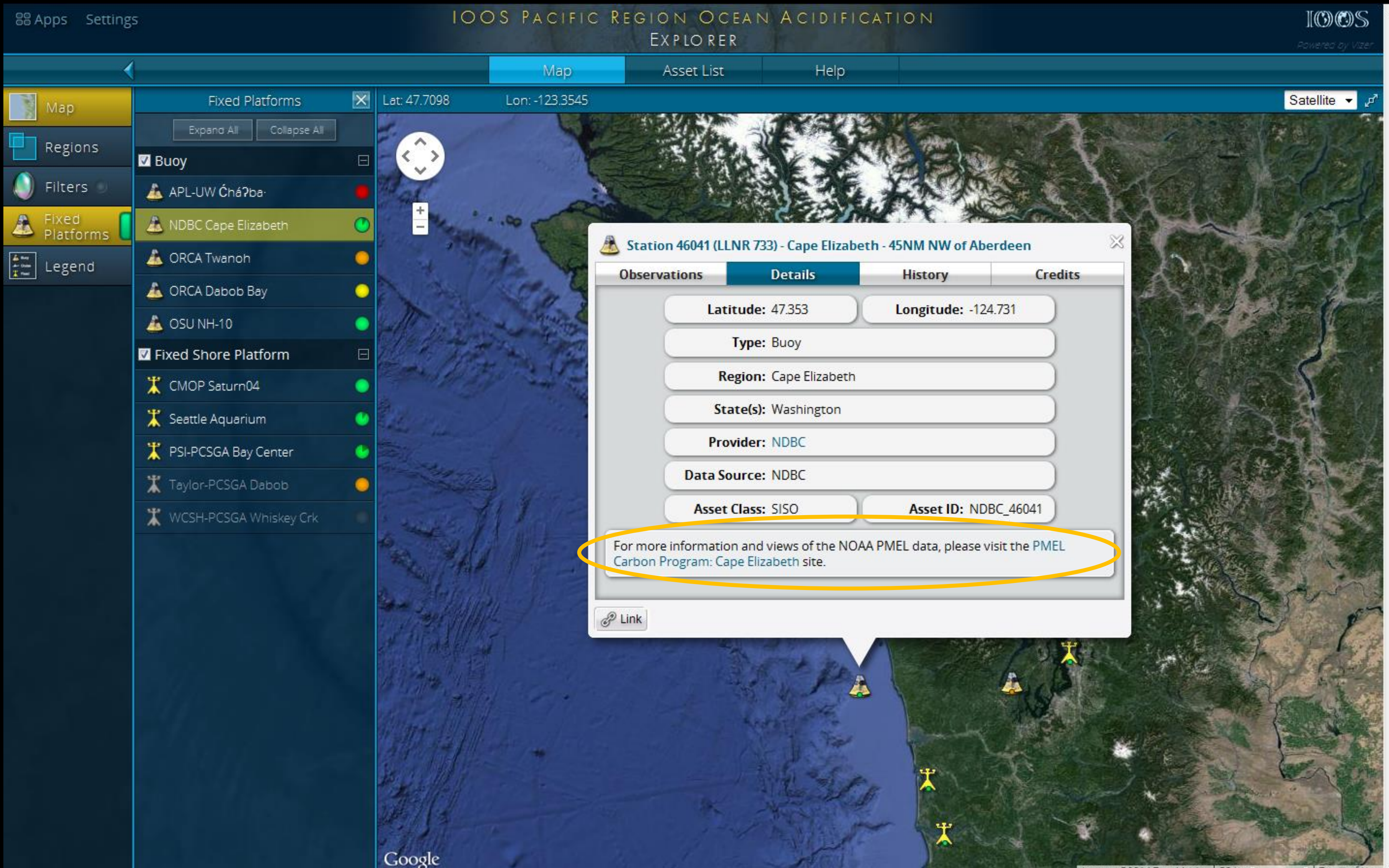
Taylor-PCSGA Dabob

Experiencing telemetry problems since 5/21/2014. Deep sensors will be serviced soon; shallow sensors will remain offline longer but will be overhauled with a more extensive suite

To be launched soon!!



To be launched soon!!



To be launched soon!!

story/Cape+Elizabeth Google

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PMEL
CARBON PROGRAM

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CONTACT US PARTNERS INTERNAL SITE MAP

Home Research Observations Outreach & Education Data Portal People News

Cape Elizabeth

National Data Buoy Center buoy at Cape Elizabeth, WA (47.35°N 124.73°W)

The U.S. Northwest coast is a region of dynamic and intense carbon cycling and may be particularly vulnerable to ocean acidification due to a combination of anthropogenic and natural processes. Along the U.S. West Coast, winds blow from north to south during spring and summer months, displacing surface water offshore. Deeper water rich in CO_2 and nutrients and depleted in O_2 upwells to the surface nearshore to replace the displaced surface water. This upwelling results in very high frequency variability in many parameters. In an effort to document the temporal patterns and magnitude of this variability, the PMEL carbon group deployed a MAPCO$_2$ system on a NOAA National Data Buoy Center (NDBC) mooring off the Washington State coast on June 21, 2006. The **NDBC mooring 46041** is located 45 nautical miles Northwest of Aberdeen, Washington. It is located near the edge of the continental shelf in 125 m of water, so it is well situated to document the upwelling events in the spring and summer.

On August 8, 2012, a surface seawater pH sensor was added to the Cape Elizabeth Mooring mooring. By measuring pH in addition to pCO_2, we are able to more accurately and precisely study the changes associated with ocean acidification. All seawater pH observations are shown in the second figure below.

RELATED STORIES

Open Ocean Moorings

The PMEL carbon group is developing a network of carbon dioxide systems on deep water moorings. ...

Finalized Data availability: submitted to **Carbon Dioxide Information Analysis Center (CDIAC)**.

Plots of surface water and atmospheric CO_2:

ory/Cape+Elizabeth

Google

Free Hotmail | Suggested Sites | Web Slice Gallery

RELATED STORIES

Open Ocean Moorings

The PMEL carbon group is developing a network of carbon dioxide systems on deep water moorings. ...

La Push

A MAPCO2 system is located on the La Push Mooring at 47.97N°, 124.95°W ...

Coastal Moorings

The PMEL carbon group is developing a network of carbon dioxide systems on coastal moorings. ...

Twanoh

A MAPCO2 system is located on the ORCA Mooring at 47.37N°, 123.01°W. ...

Dabob

A MAPCO2 system is located on the ORCA Mooring in Dabob Bay (47.80°N, 122.80°W) ...

Coral Reef Moorings

The PMEL carbon group is developing a network of carbon dioxide systems on coastal moorings. ...

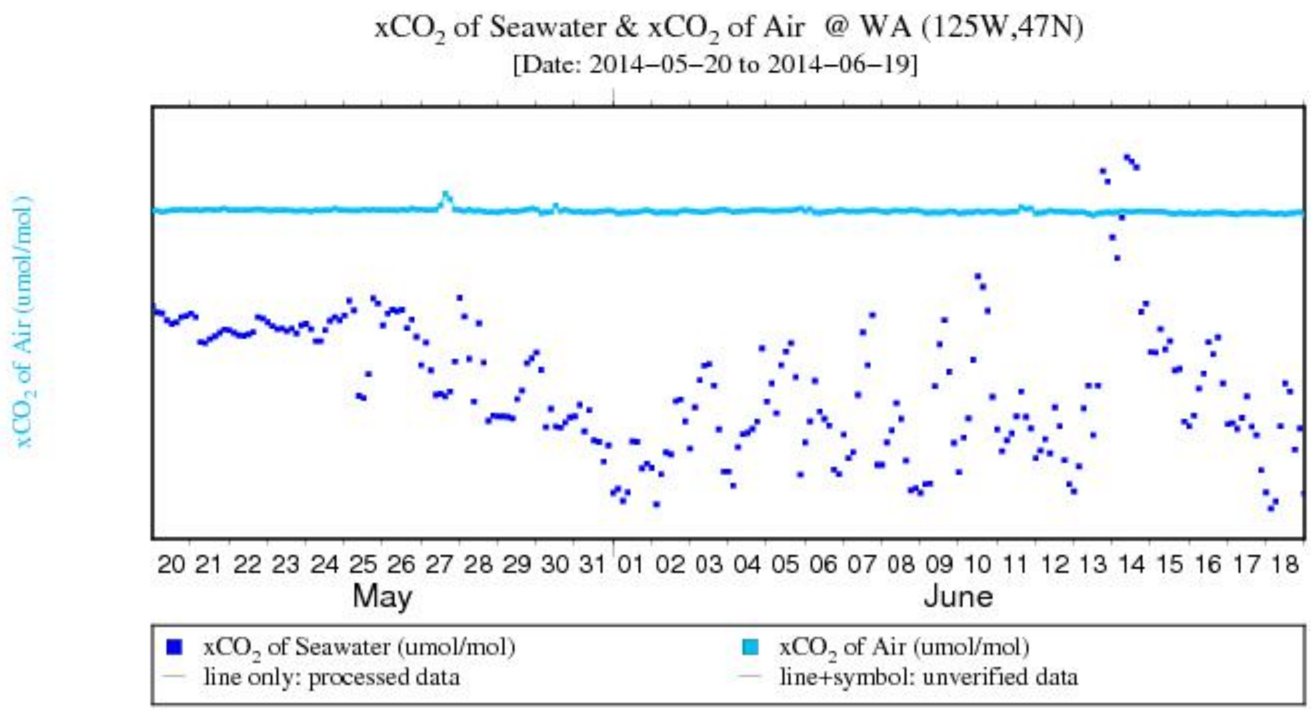
In addition to pCO_2, we are able to more accurately and precisely study the changes associated with ocean acidification. All seawater pH observations are shown in the second figure below.

Finalized Data availability: submitted to **Carbon Dioxide Information Analysis Center (CDIAC)**.

Plots of surface water and atmospheric CO_2:

Data are unverified

Click to show last 30 days | Click to show full data set



Using ocean data-
Why bother?

- Using real ocean data engages students and gets them to use technology and information just as researchers do: students can formulate and test hypotheses and refine their ideas
  - Capture their interest in science and investigation
  - Apply students' savvy internet skills in the science classroom

- Using real ocean data can make what happens in the classroom relevant to student's lives
  - Bring in the world of high-tech instruments and real-time data
  - Provide stronger sense of authenticity to your teaching

Q: How familiar are you with real-time OA data?

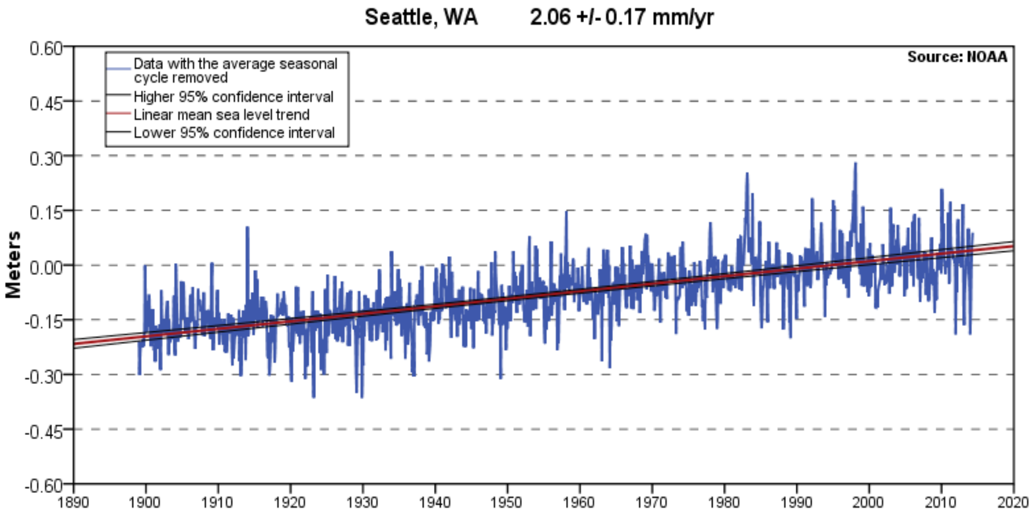
- Very familiar, I use it regularly
- Somewhat familiar, I know of it
- I would use it if I knew where to find it
- Not at all familiar

How best to use real-time data?

- Global issues versus real-time data
  - Sea level rise
  - Global warming
  - Ocean acidification

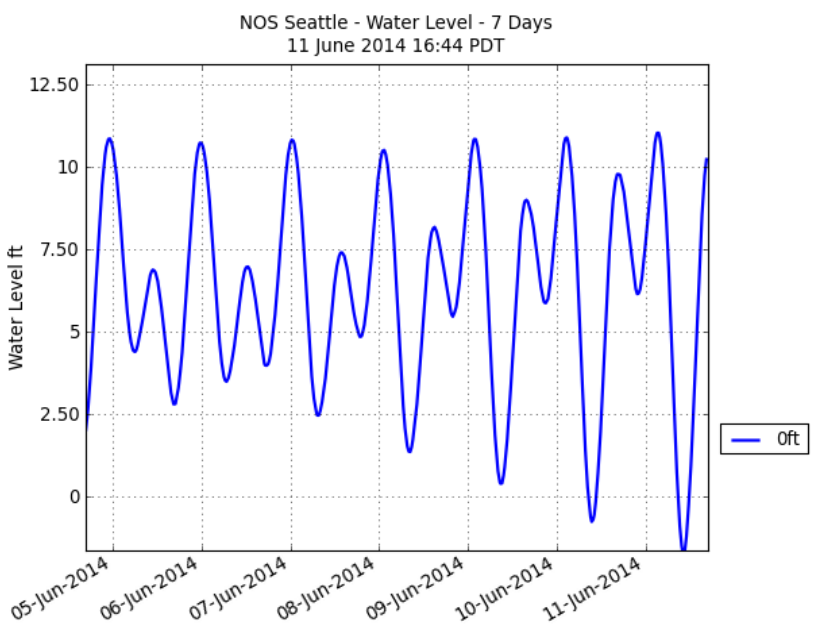
- Challenge: time scales
- Challenge: knowledge of the causes of variation

Sea Level Rise



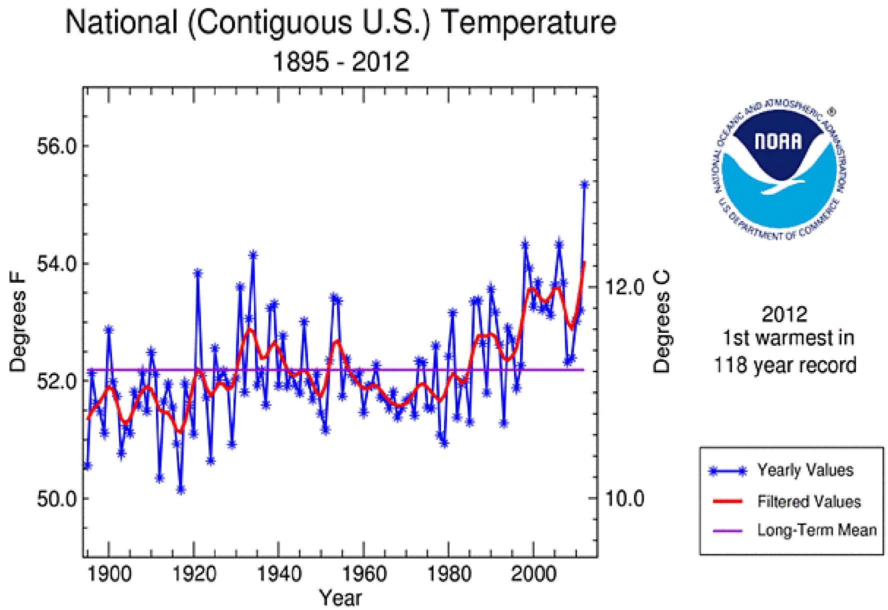
The mean sea level trend is 2.06 millimeters/year with a 95% confidence interval of +/- 0.17 mm/yr based on monthly mean sea level data from 1898 to 2006 which is equivalent to a change of 0.68 feet in 100 years.

http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9447130

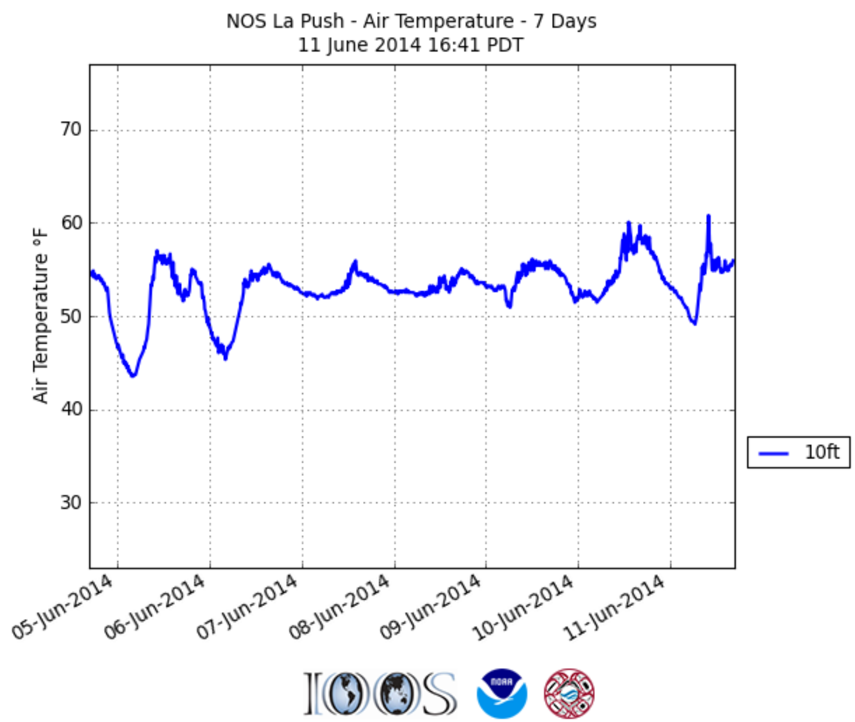


Real time water level data

Global warming



http://www.ncdc.noaa.gov/cag/time-series/global



Real-time air temperature data

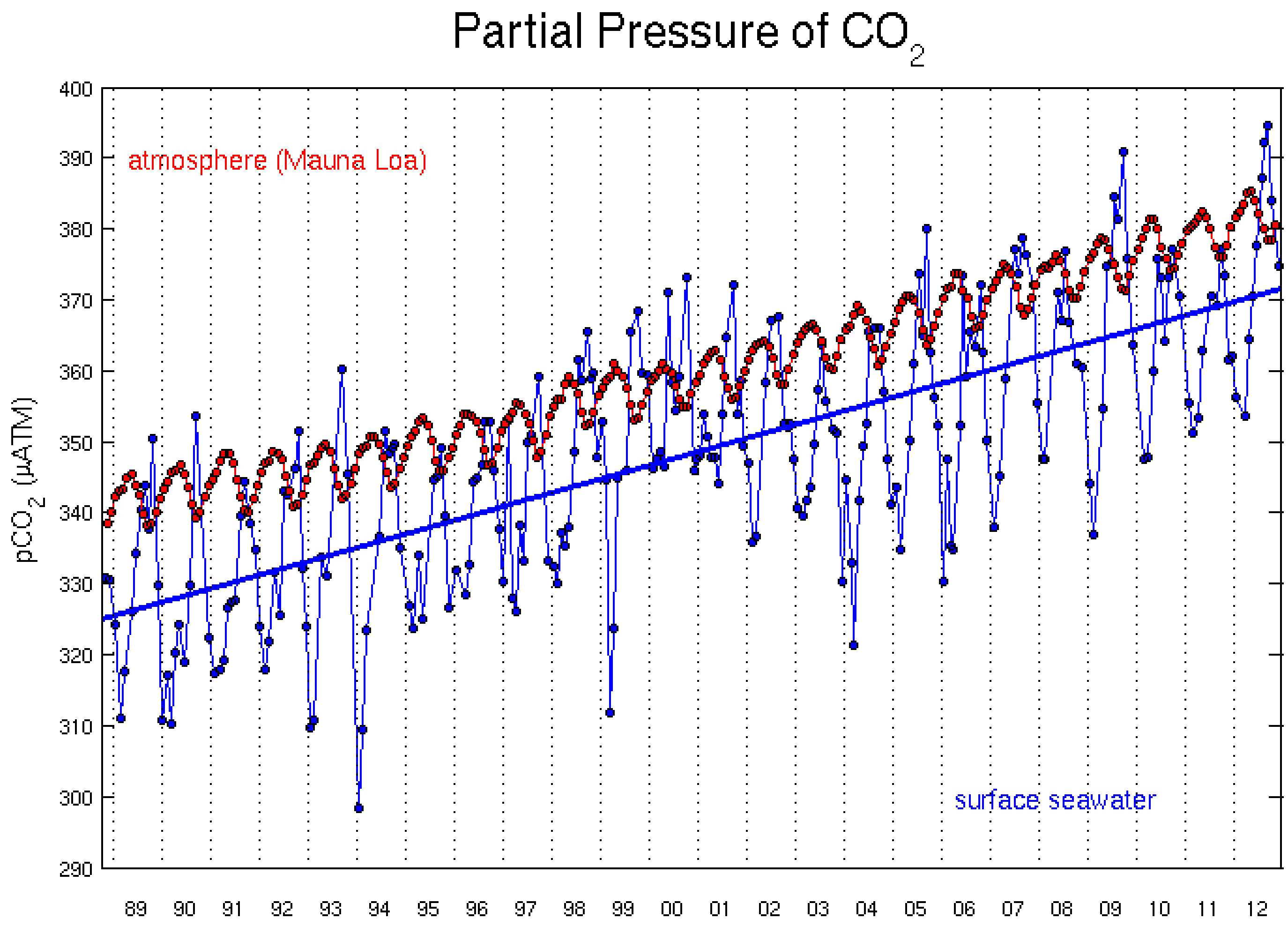
Ocean acidification

- Atmospheric CO_2 (both xCO_2 and pCO_2)
- Seawater CO_2 (ditto)
- Seawater pH

- Saturation state (Ω) aragonite or calcite

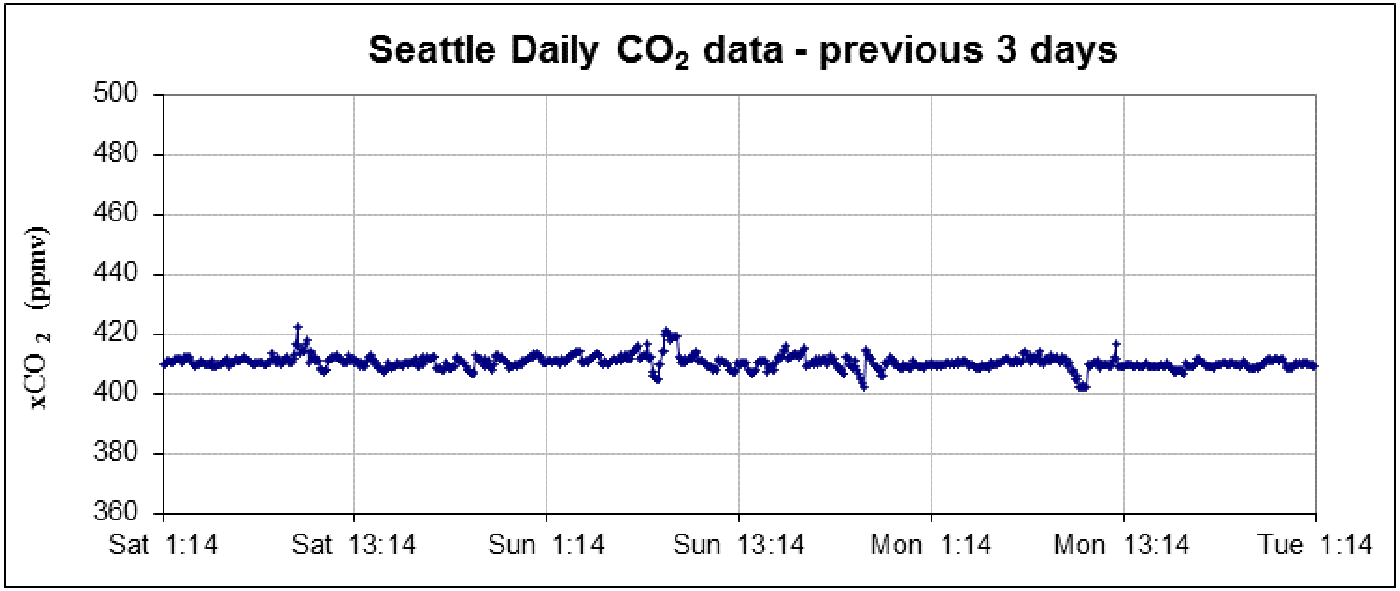
Complicated story…

Trends in air and seawater pCO_2

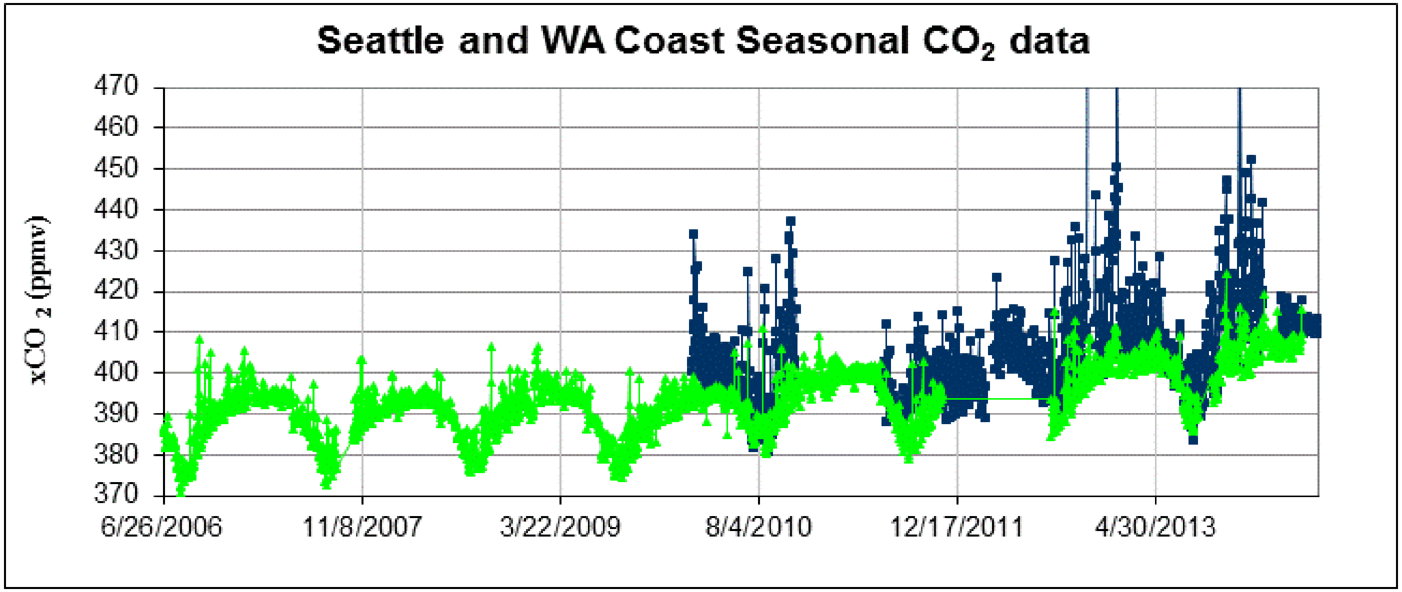


http://hahana.soest.hawaii.edu/hot/trends/trends.html

Atmospheric xCO_2



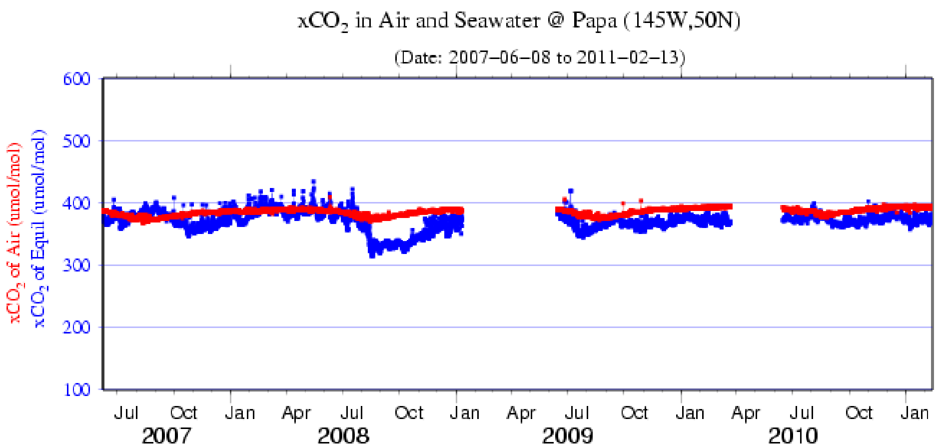
http://www.pmel.noaa.gov/co2/story/Space+Needle

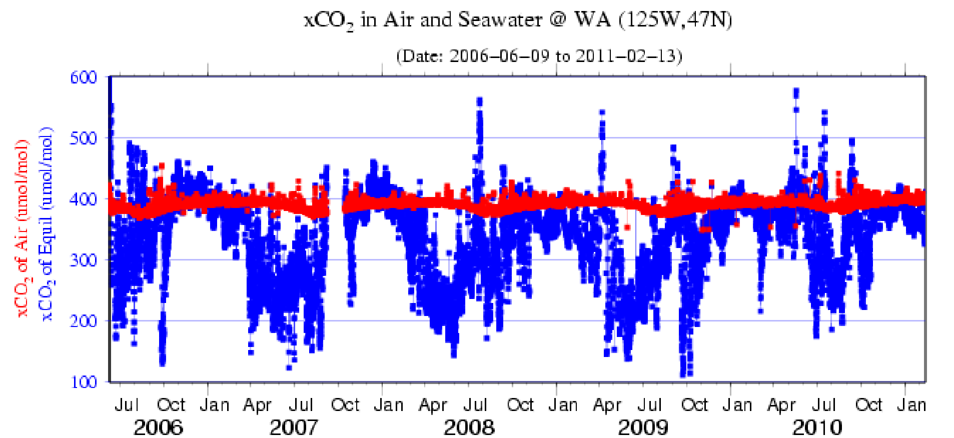


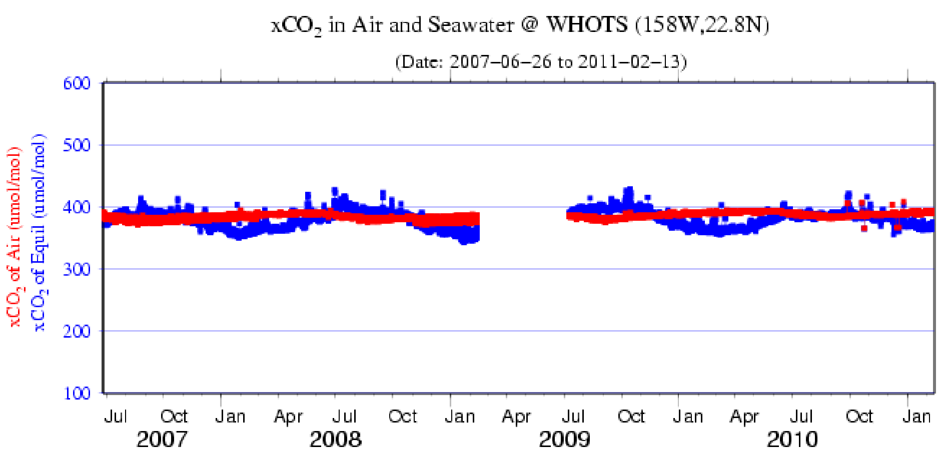
Blue: Space Needle in Seattle

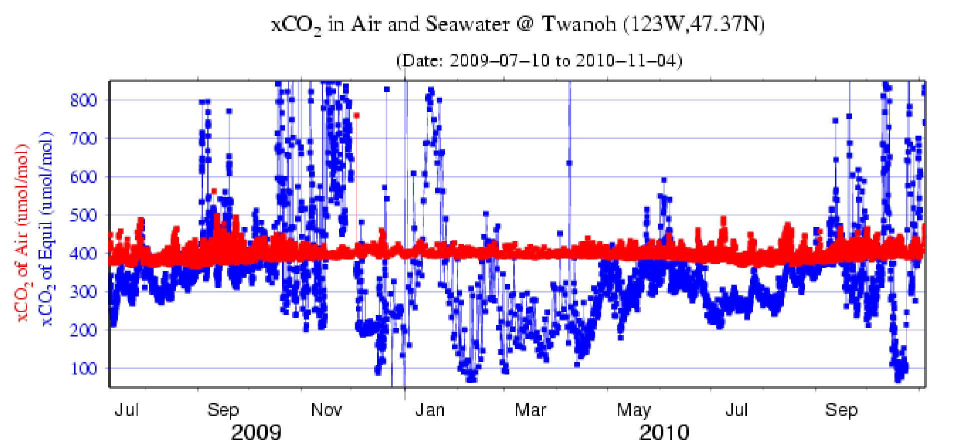
Green: Buoy off Coast

Variability is much larger in coastal waters than the open ocean, then there are estuaries









Courtesy C. Sabine, NOAA PMEL

So HELP !!

- So many variables
- So much variation

- Can I really use real-time OA data ???

- Lets get to the basics of what affects the OA variables…

Processes that fuel increased respiration yield higher CO_2, lower pH, and lower O_2

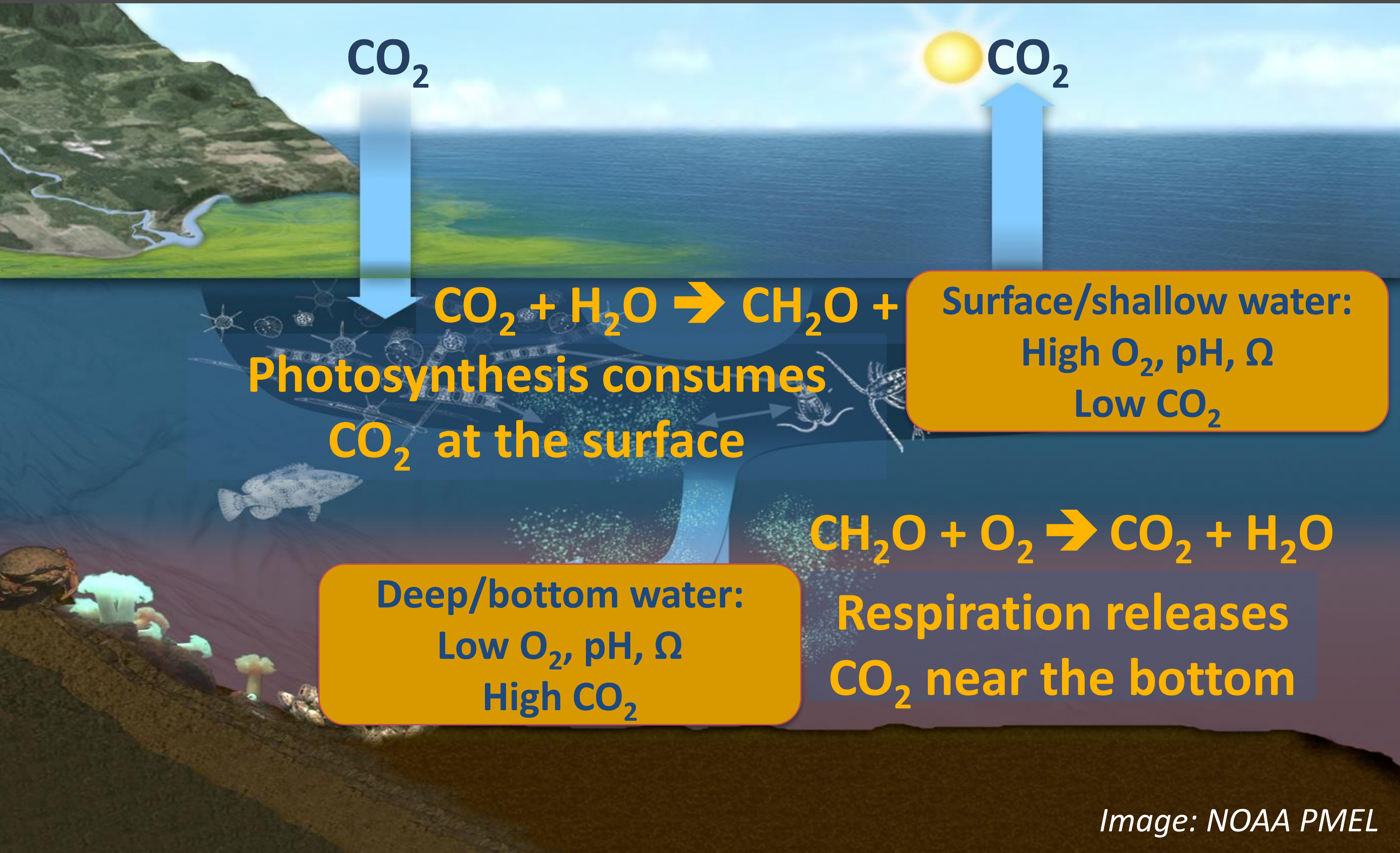


Image: NOAA PMEL

Processes that fuel increased respiration yield higher CO_2, lower pH, and lower O_2

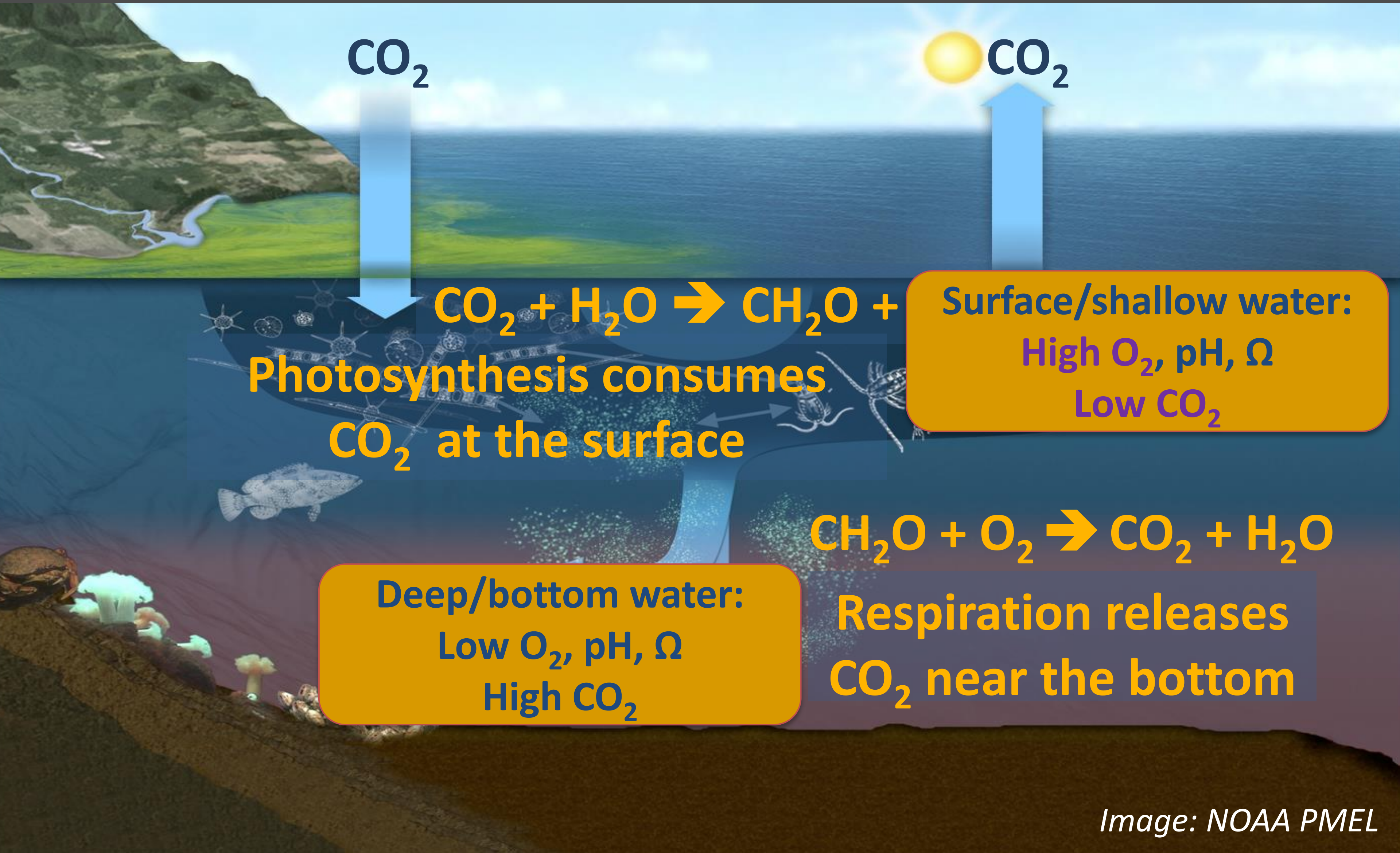
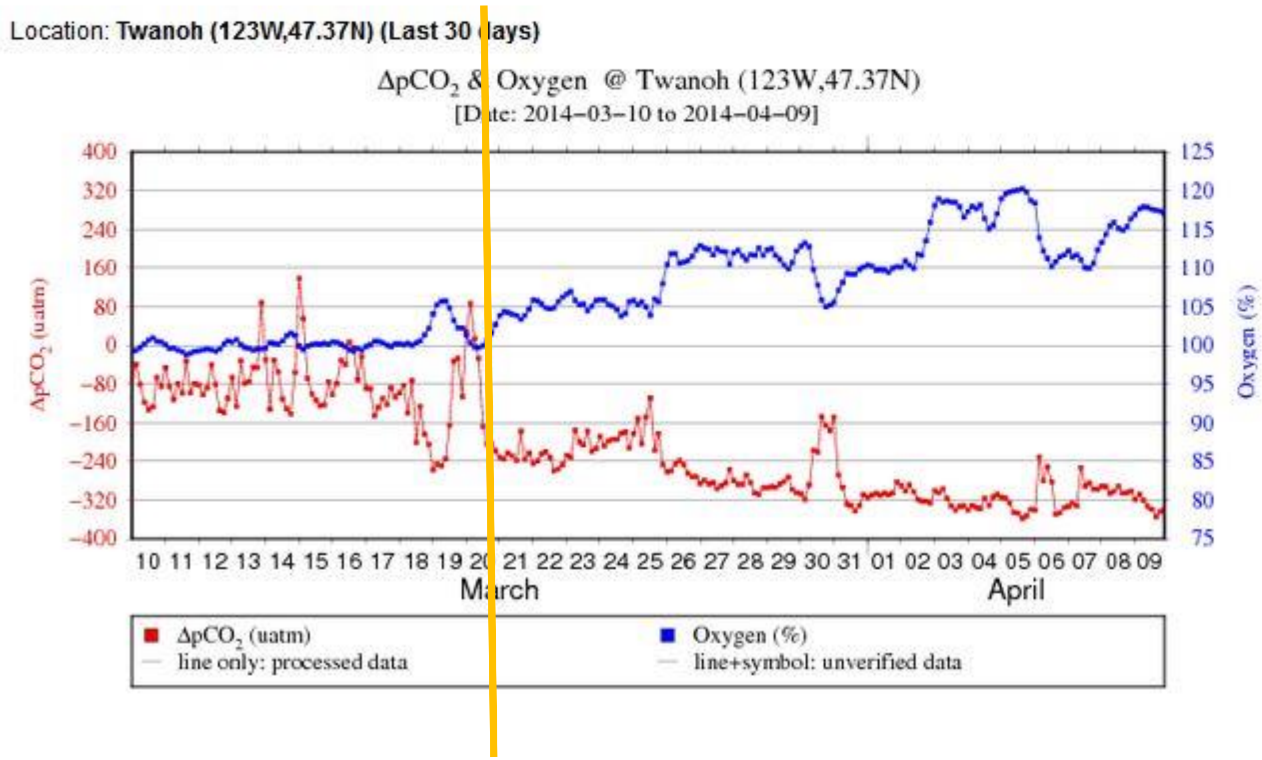


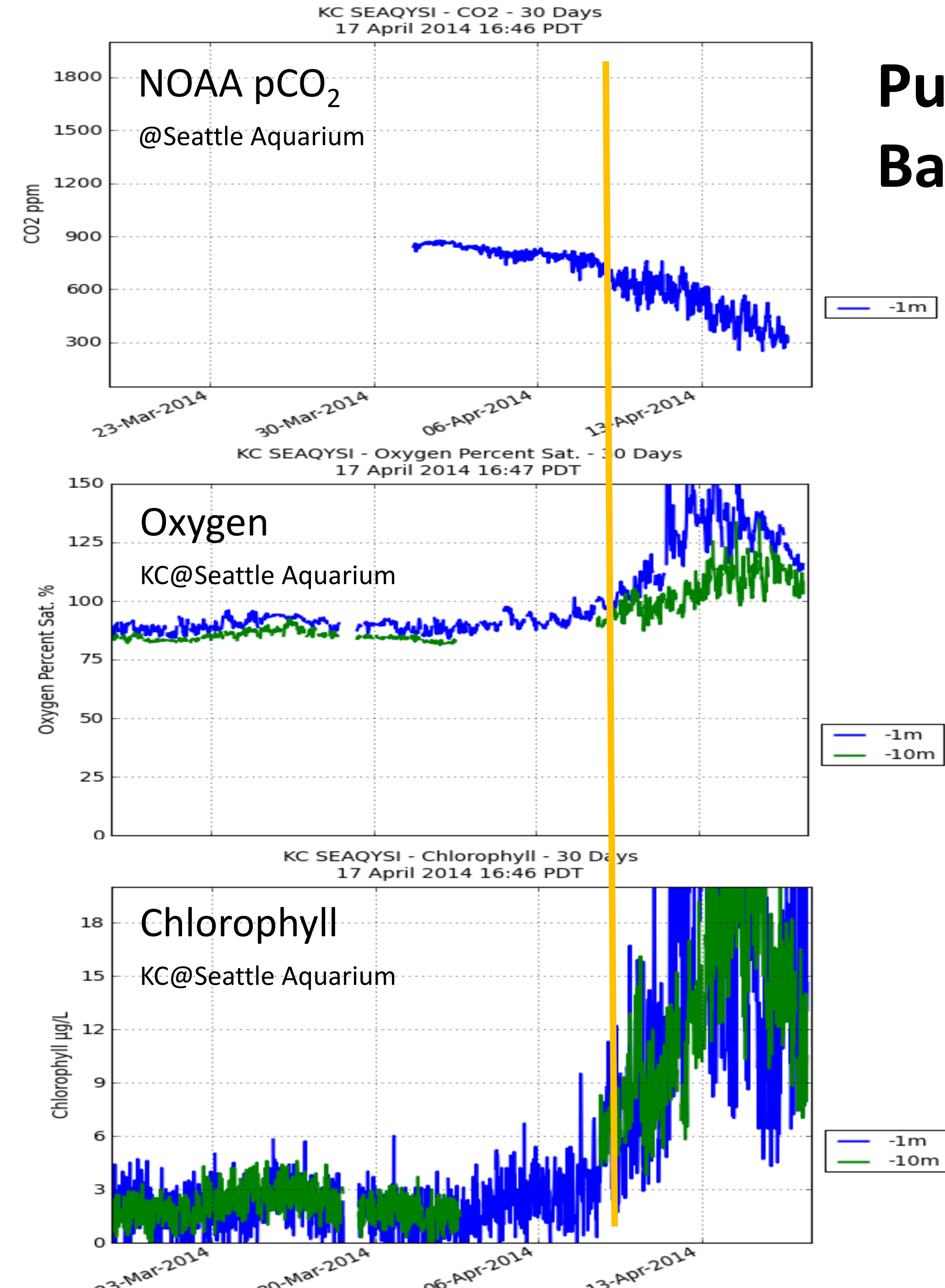
Image: NOAA PMEL

Southern Hood Canal at Twanoh



Hello Spring Bloom !!

NOAA PMEL – NANOOS collaboration



Puget Sound Main Basin at Seattle

Spring Bloom here too, but later…classic Sverdrup (1942) "critical depth" explanation !

Seattle Aquarium – King County – NOAA PMEL – NANOOS collaboration

Seasonal upwelling brings high CO_2, low pH, low oxygen water to surface

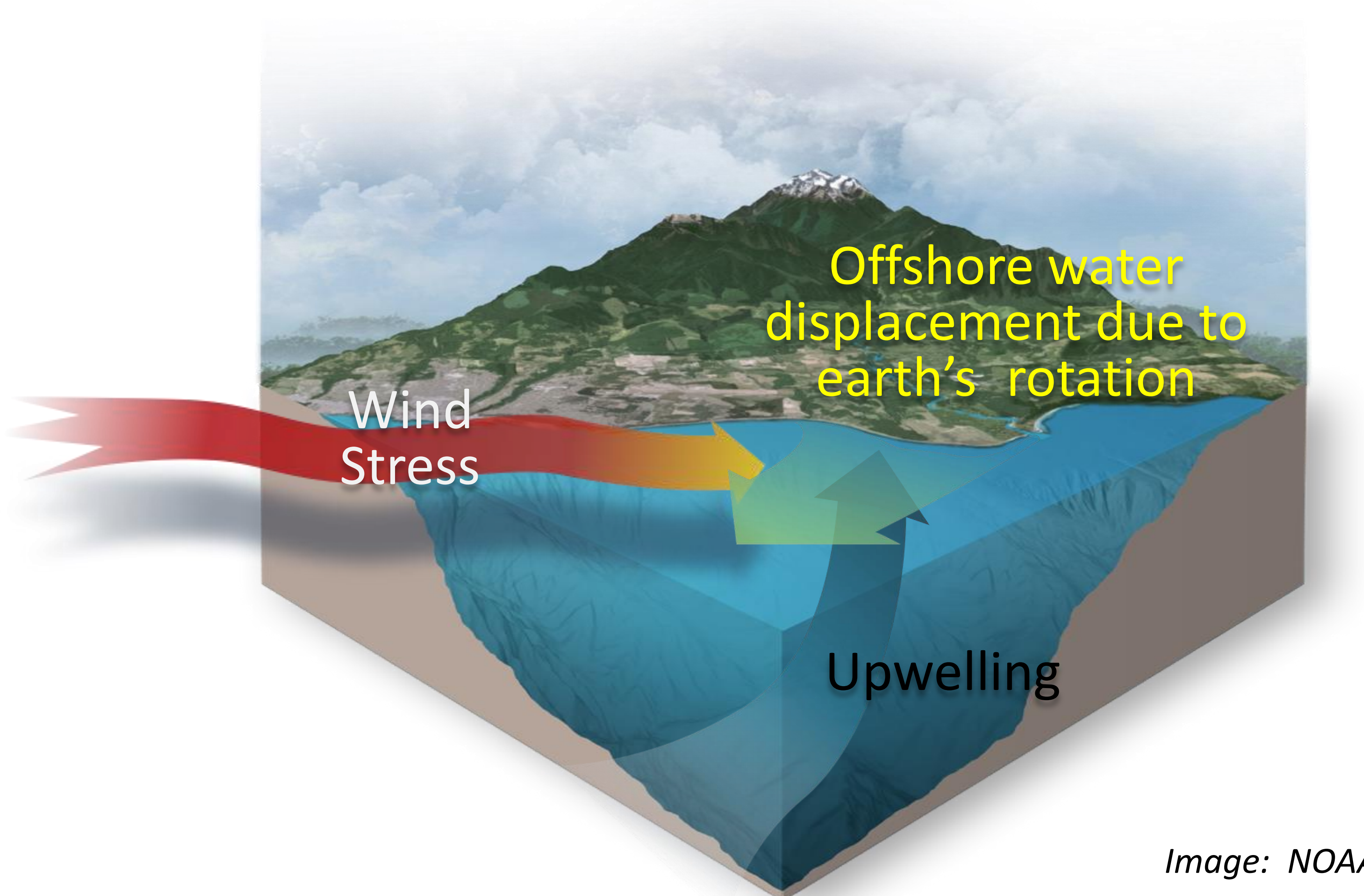
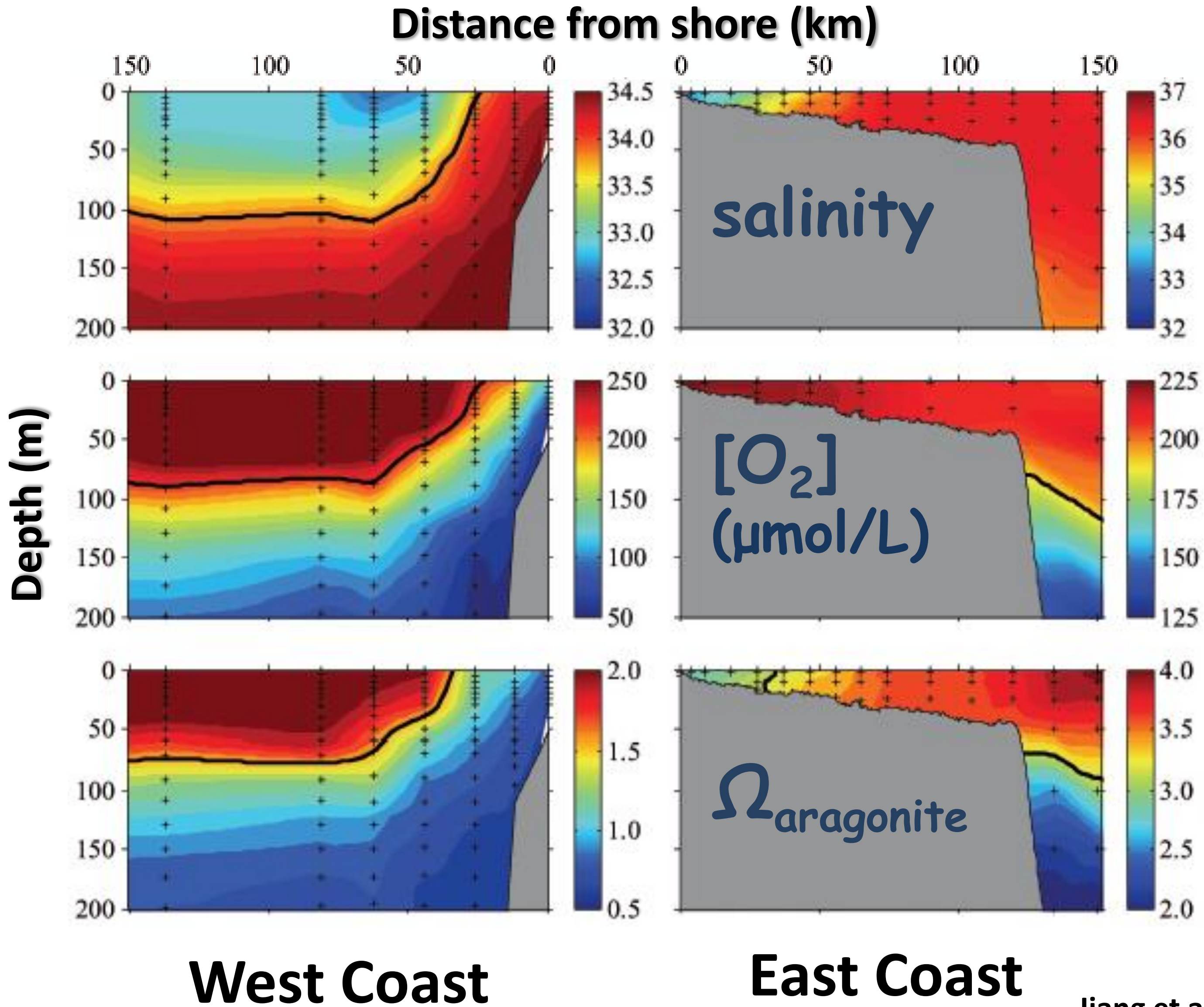


Image: NOAA PMEL

Ocean Acidification: Upwelling



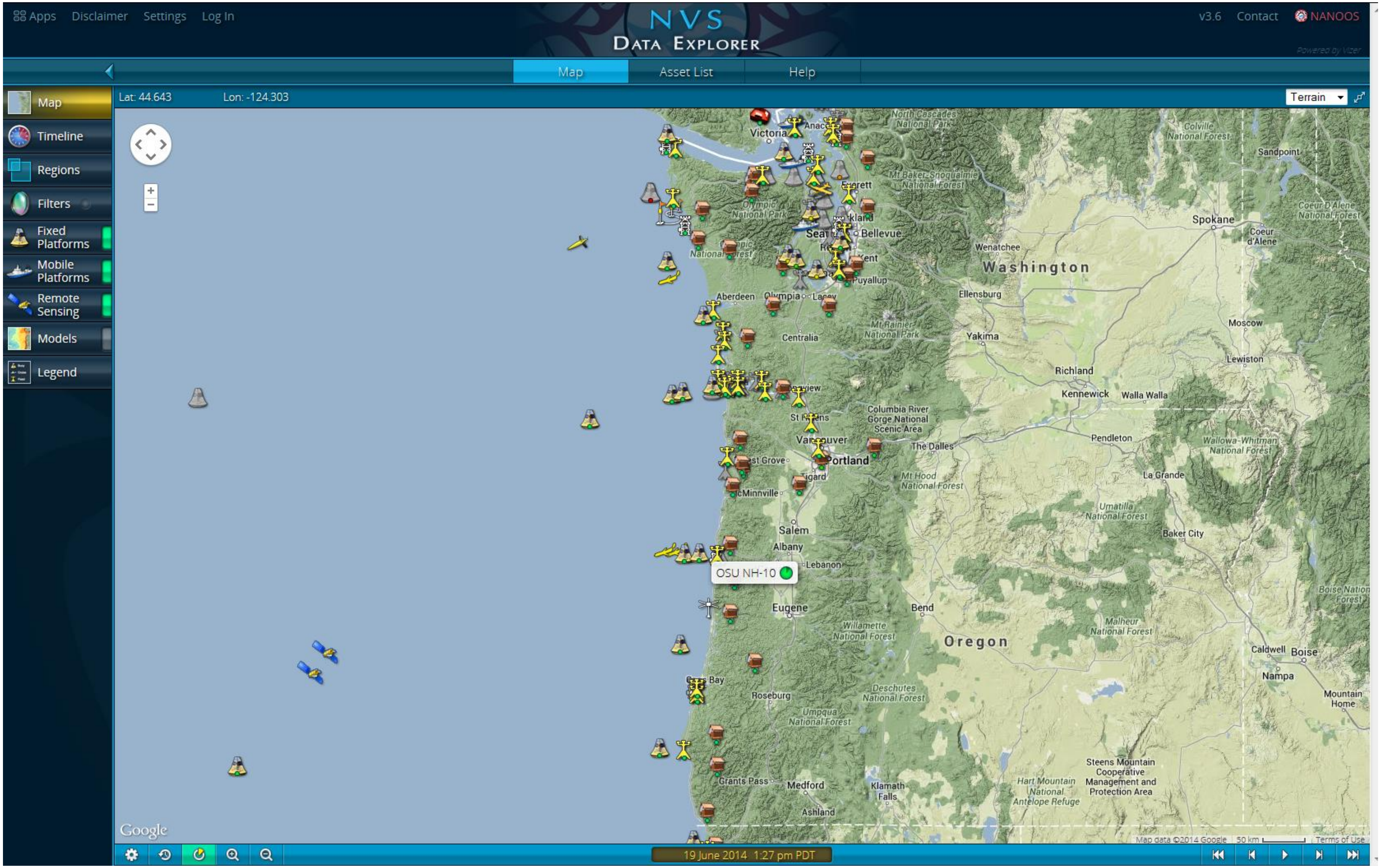
Jiang et al., L&O, 2010

What are the upwelling conditions along the West Coast today?

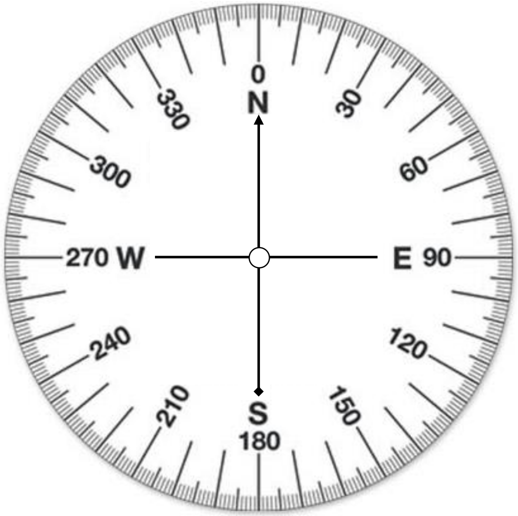
What variables might you want to look into?

Use IOOS data to find out!

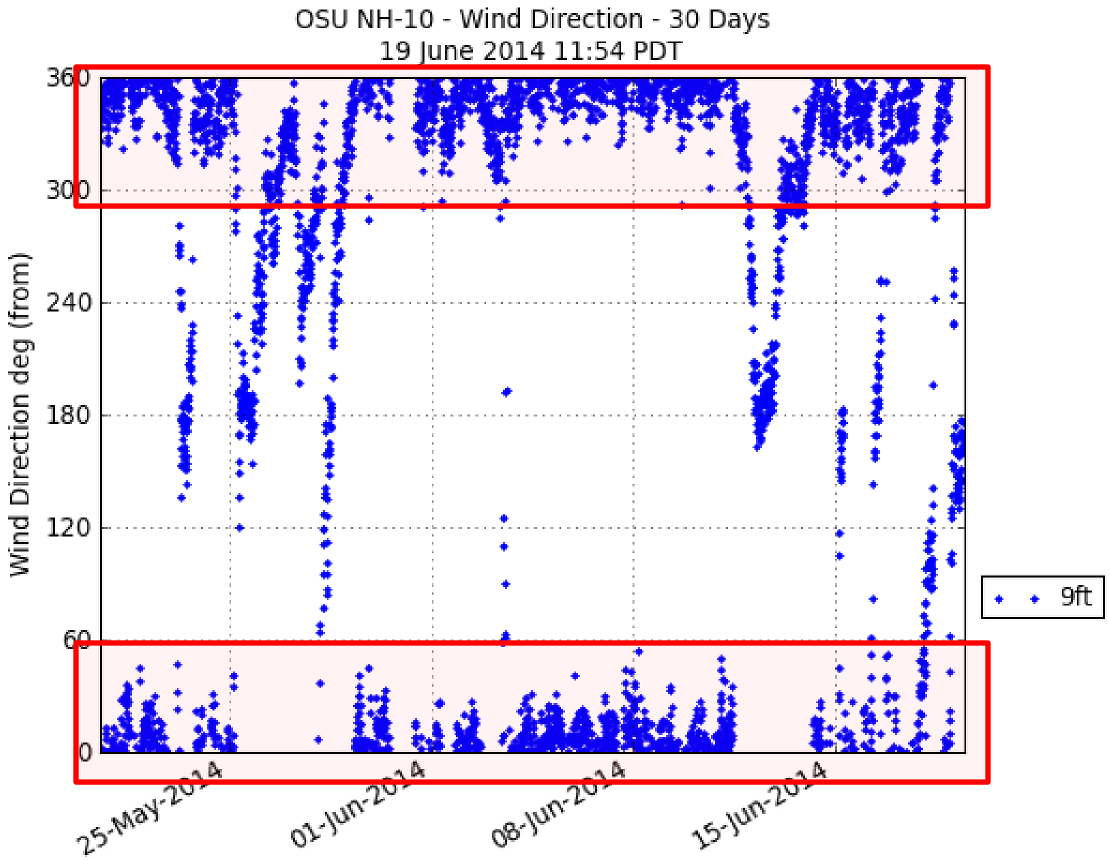
Data explorer



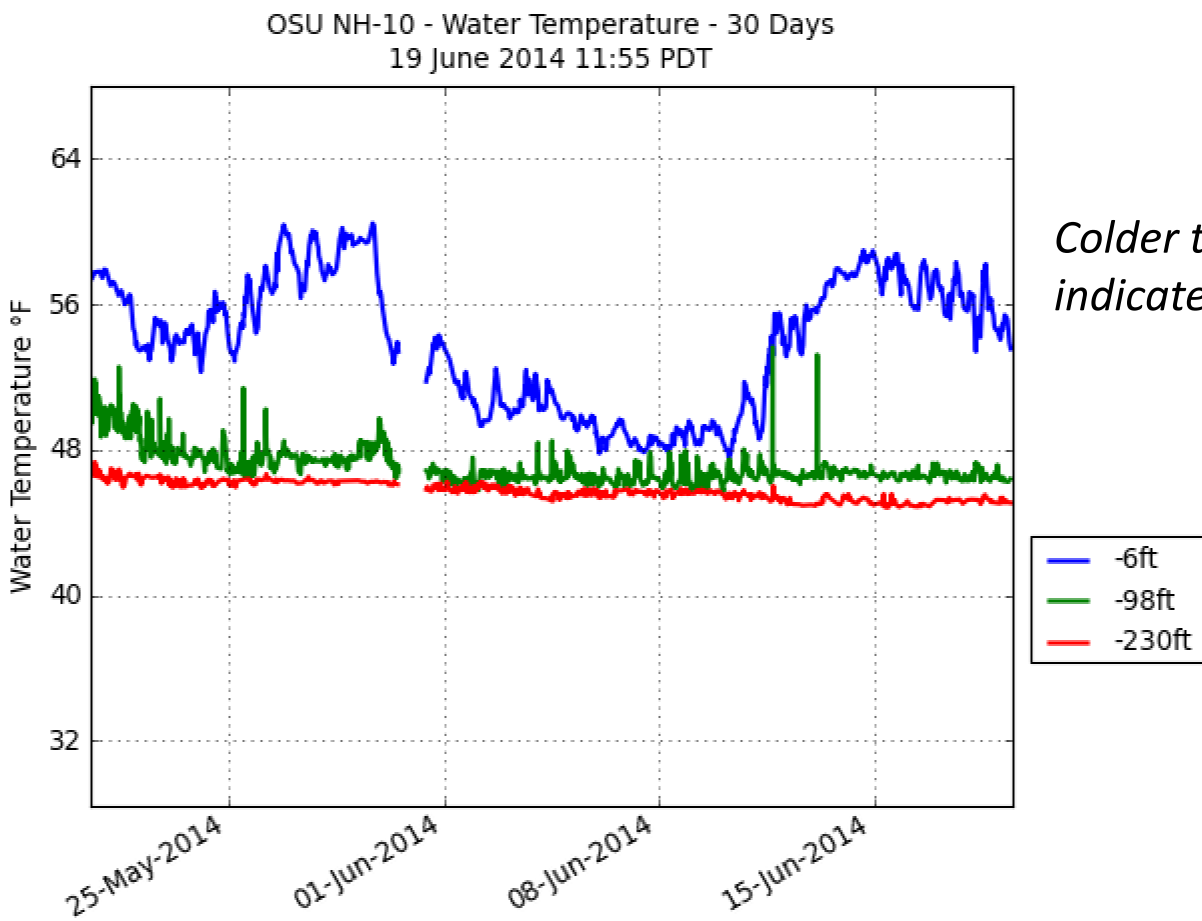
Wind direction



Between 300 and 60 degrees is upwelling favorable

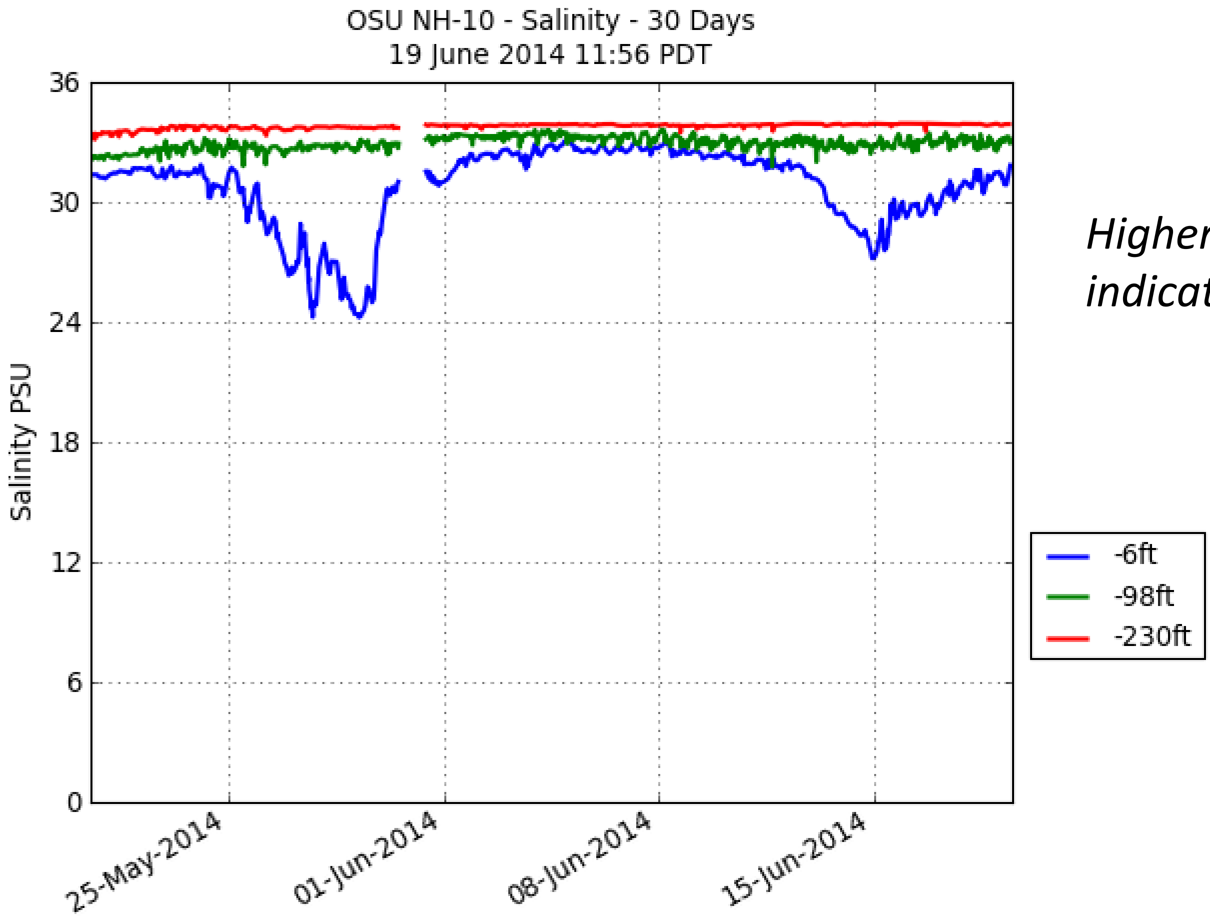


Seawater temperature



Colder temperature indicates deep waters

Salinity



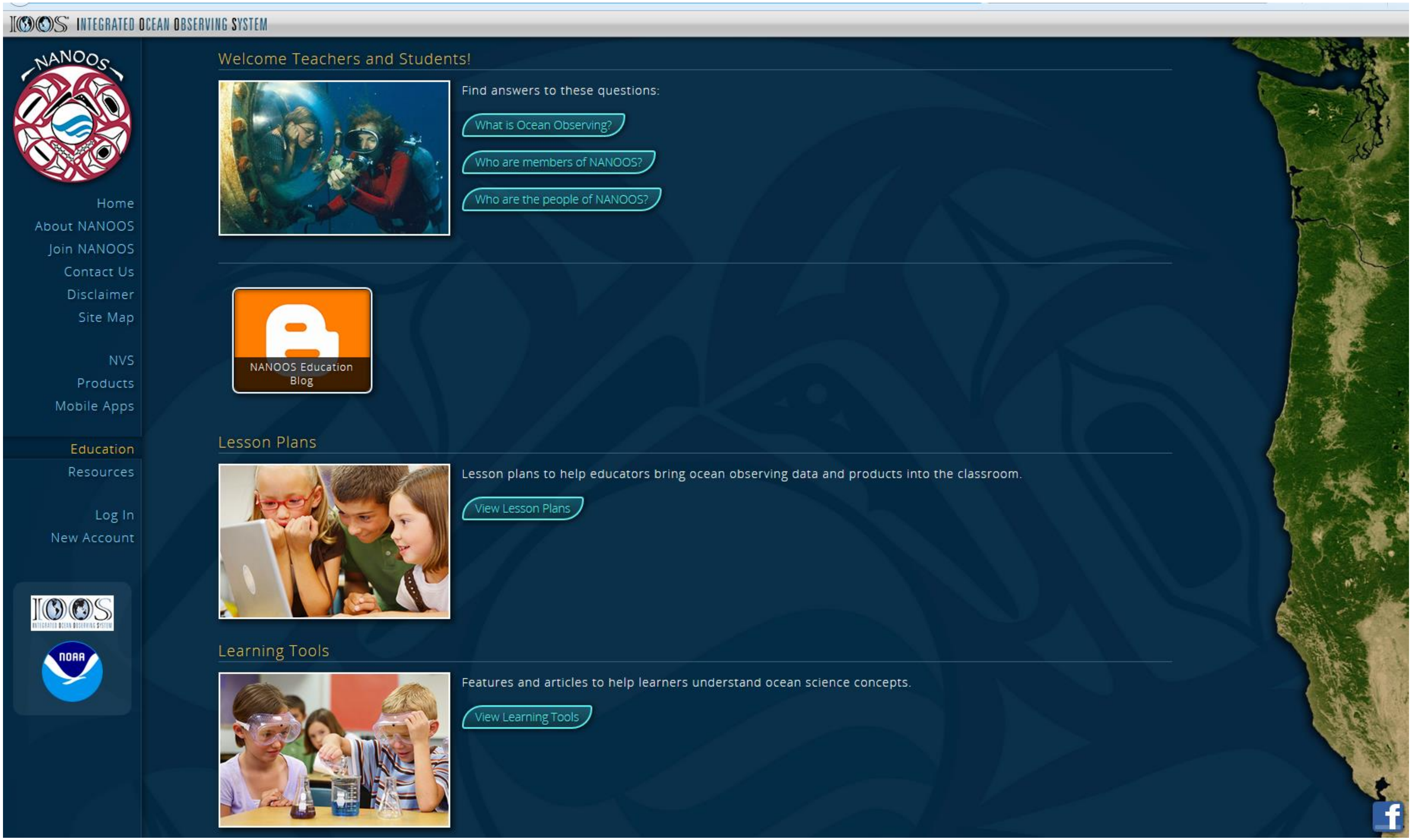
Higher salinity indicates deep waters

How best to use real-time data for studying OA?

- Reinforce basic scientific principles
  - Photosynthesis and Respiration
  - Upwelling
  - Spatial scales of variation
    - e.g., coastal vs. open ocean
  - Temporal scales of variation
    - e.g., weeks, years, decades

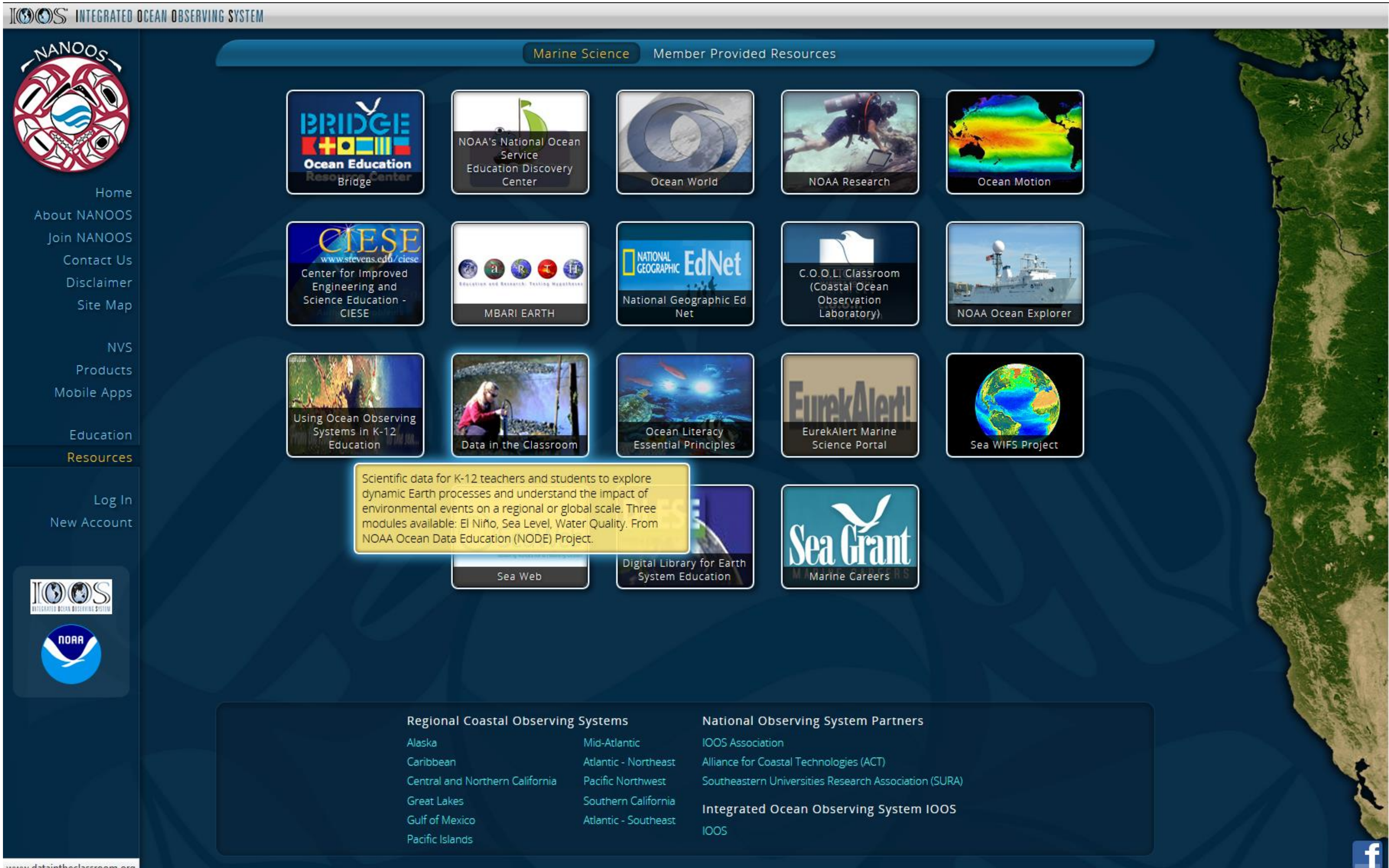
- But, you are not alone!

Educator tools



e.g., upwelling lesson plan

Education resources, including OA



Education, Outreach and Training

One stop location for formal and informal education, training and outreach materials that use ocean observing information about physical, chemical, geological, and biological changes in our oceans, coasts, and Great Lakes.

New: Training Resources

Training resources aim to help users understand what ocean observations data and information is available on websites and mobile devices and how to use them.

Education Websites | Lesson Plans | Using Real Data | Multimedia

Regional Education Websites

Alaska (AOOS)

- Alaska Centers for Ocean Sciences Education Excellence.
- The EARTH program uses near-real-time data from ocean observatories to design and test outreach with the Internet as an interface to scientists, teachers, students, and the public.
- Training for Coastal Managers, climate change, coastal communities, coastal processes, data products.

Kasitsna Bay Earth Workshop, 2011 - 20 teachers focused on developing curriculum for the Gulf of Alaska. The workshop was in partnership with COSEE Alaska, the North Pacific Research Board, the Monterey Bay Aquarium and Research Institute, and AOOS.

Caribbean (CariCOOS)

- The CariCOOS Education section provides data visualization of waves, winds, currents, water quality and coastal flooding in real time to the various users of coastal waters such as recreational and commercial fishermen, surfers, swimmers, sailors, students, researchers, government regulatory agencies, and emergency management agencies, among others.

Outreach and Communication Resources

Flyers, fact sheets, brochures, messaging materials, and press releases

Events

IOOS Participates in the National Marine Educators Association (NMEA) Conference, June 2012

About this conference

Eyes on the Ocean: Resources for educators from the Integrated Ocean Observing System

Incorporating ocean data into your curriculum can bring real-world authenticity and excitement to your classroom or learning center.

In this presentation three educators from our regional associations of our national Integrated Ocean Observing Systems (IOOS) will share a framework for teaching with data. We will also demonstrate particular data products of interest to educators from regional observing systems in Alaska, the mid Atlantic and the Pacific Northwest.