

# Ocean Acidification Regional Data



Charlotte Whitefield\* and Caren Braby  
Oregon Department of Fish and Wildlife

# Dungeness Crab Distribution

*Tri-State Dungeness Crab agreement*



# The Pacific Coast Collaborative (PCC)

## *West Coast OAH Monitoring Inventory*

Assess the OAH monitoring landscape

- ◆ Physical, Chemical, and Biological
- ◆ Financial/Operational Security

Identify the existing OAH monitoring backbone

Design of a West Coast integrated monitoring network

- ◆ Gap identification
- ◆ Information synthesis





# West Coast OAH Monitoring Inventory

**3598** line items (points or individual assets)

- **2085** from **state or federal agencies**
- **1369** from **academic researchers**
- **11** from **tribal programs**
- **116** from **non-profit organizations**
- **6** from **industry partners**

**174** different **projects**

- **94 researchers** across **93 institutions**

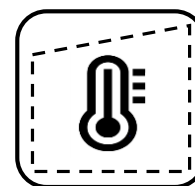
**1798** line items looking at both **physical** and **biological**

**1474** line items focused solely on **biological** research

**319** line items focused solely on **physical/chemical** research

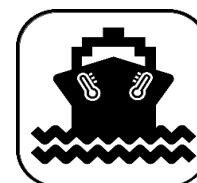
**220** assets or projects that are actively recording *in situ* measurements

**37** assets actively able to **inform OAH conditions**



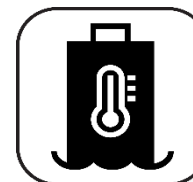
**14**  
Survey Areas

**69**  
Shore-Side  
Sensors



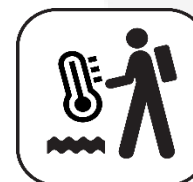
**27**  
Cruises  
&  
Gliders

**150**  
Moorings

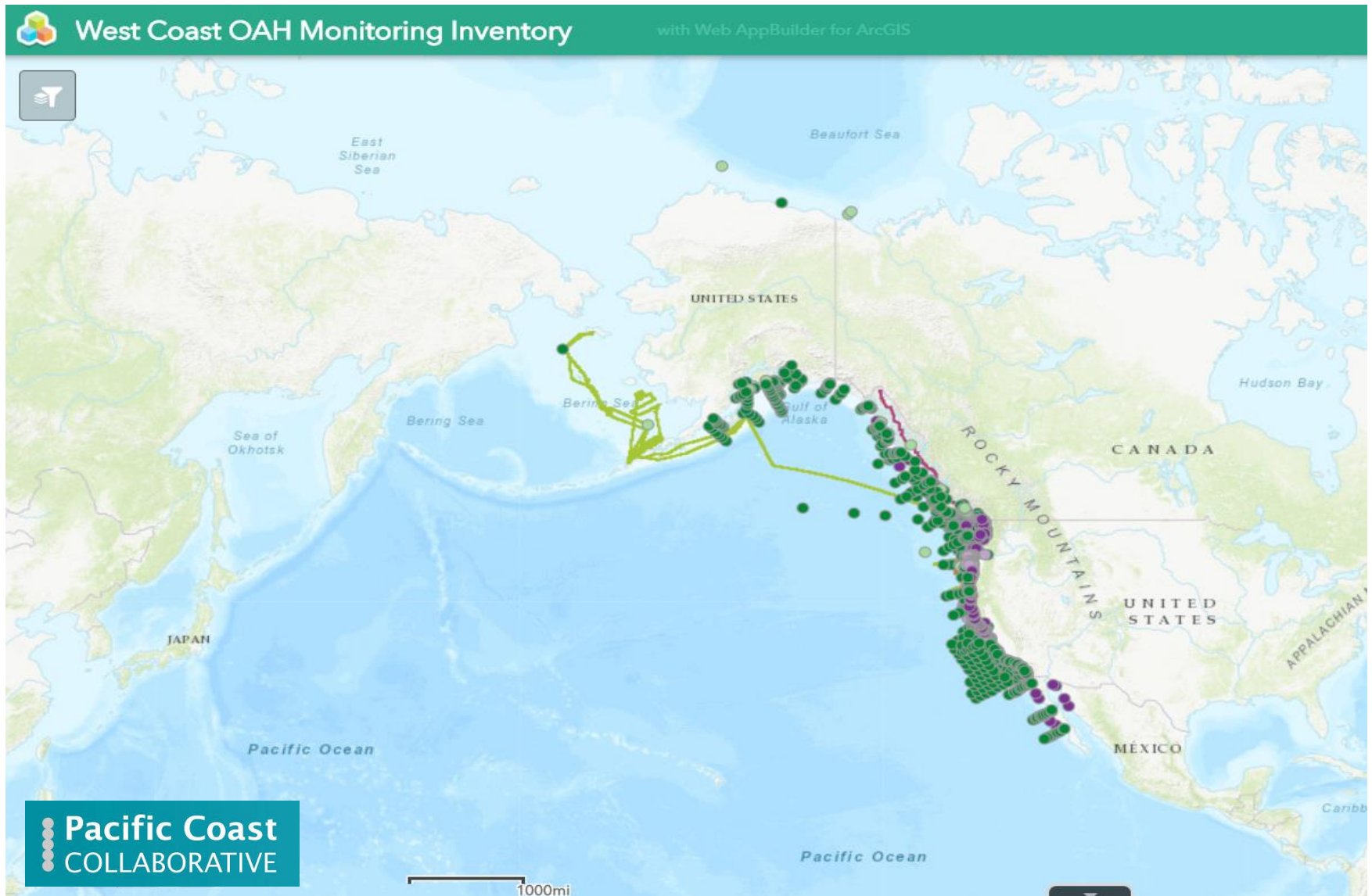


**1631**  
Cruise  
Stations

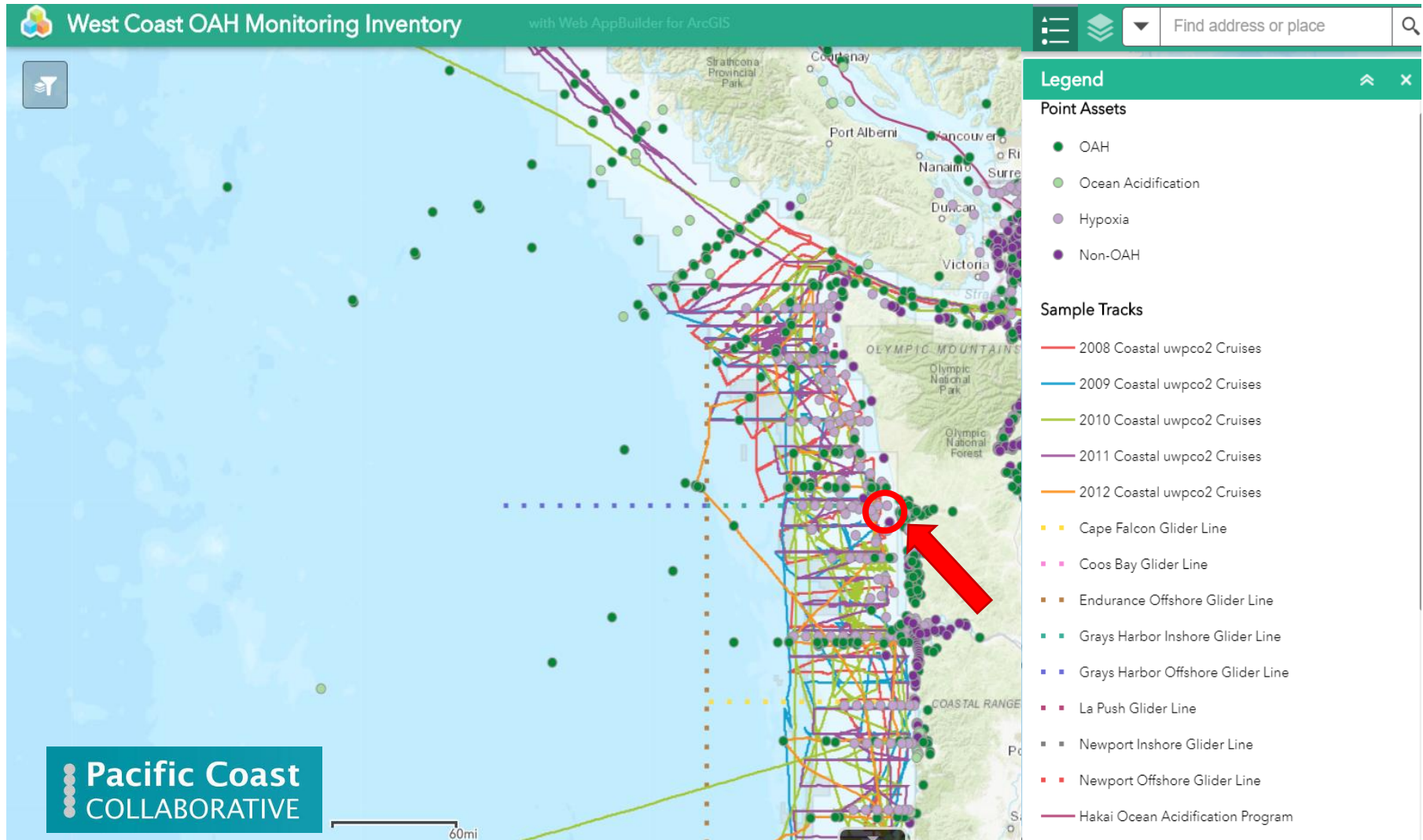
**1712**  
Sample Sites



# West Coast OAH Monitoring Inventory



# West Coast OAH Monitoring Inventory



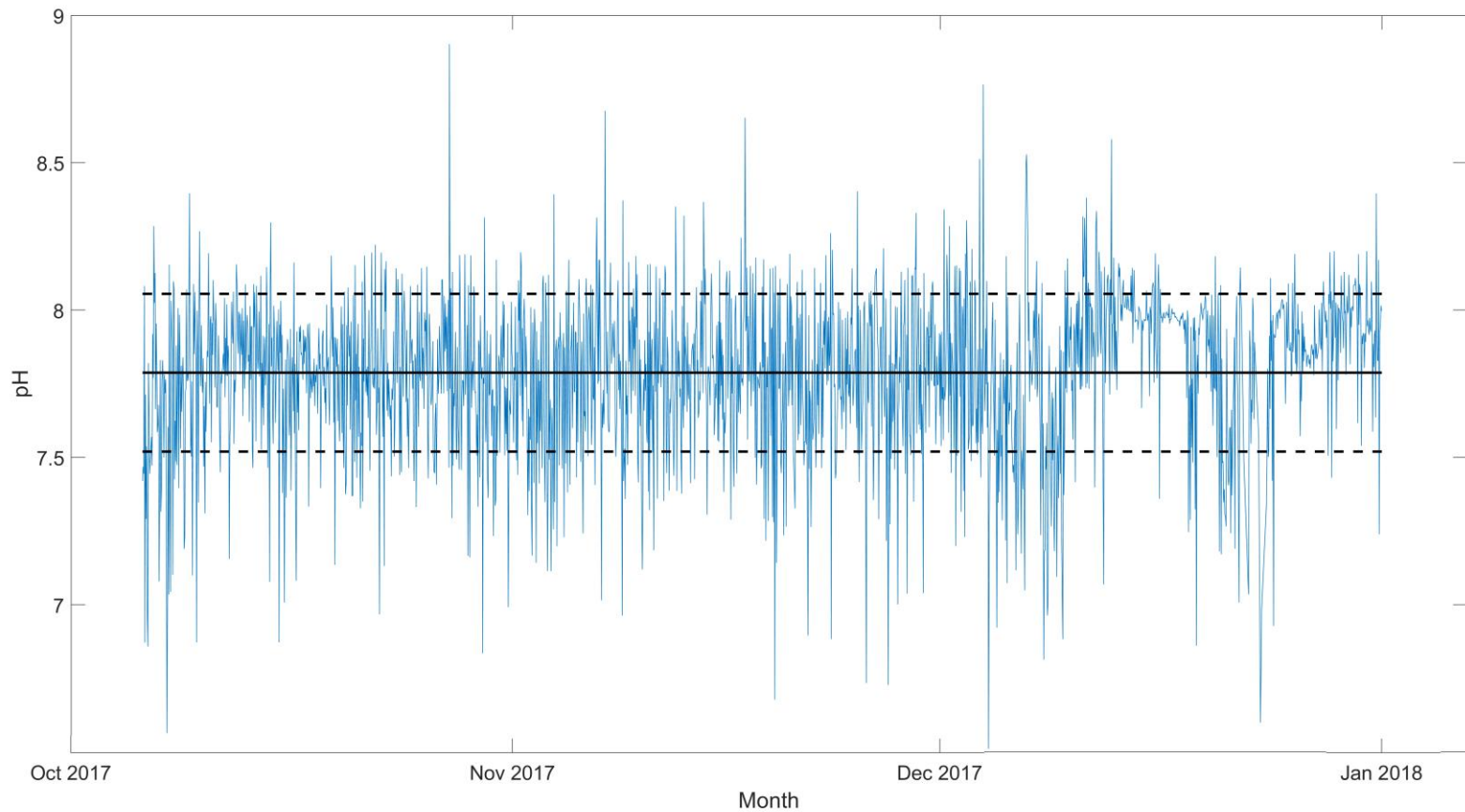
# Inshore mooring: CE06ISSM





# Inshore mooring: CE06ISSM

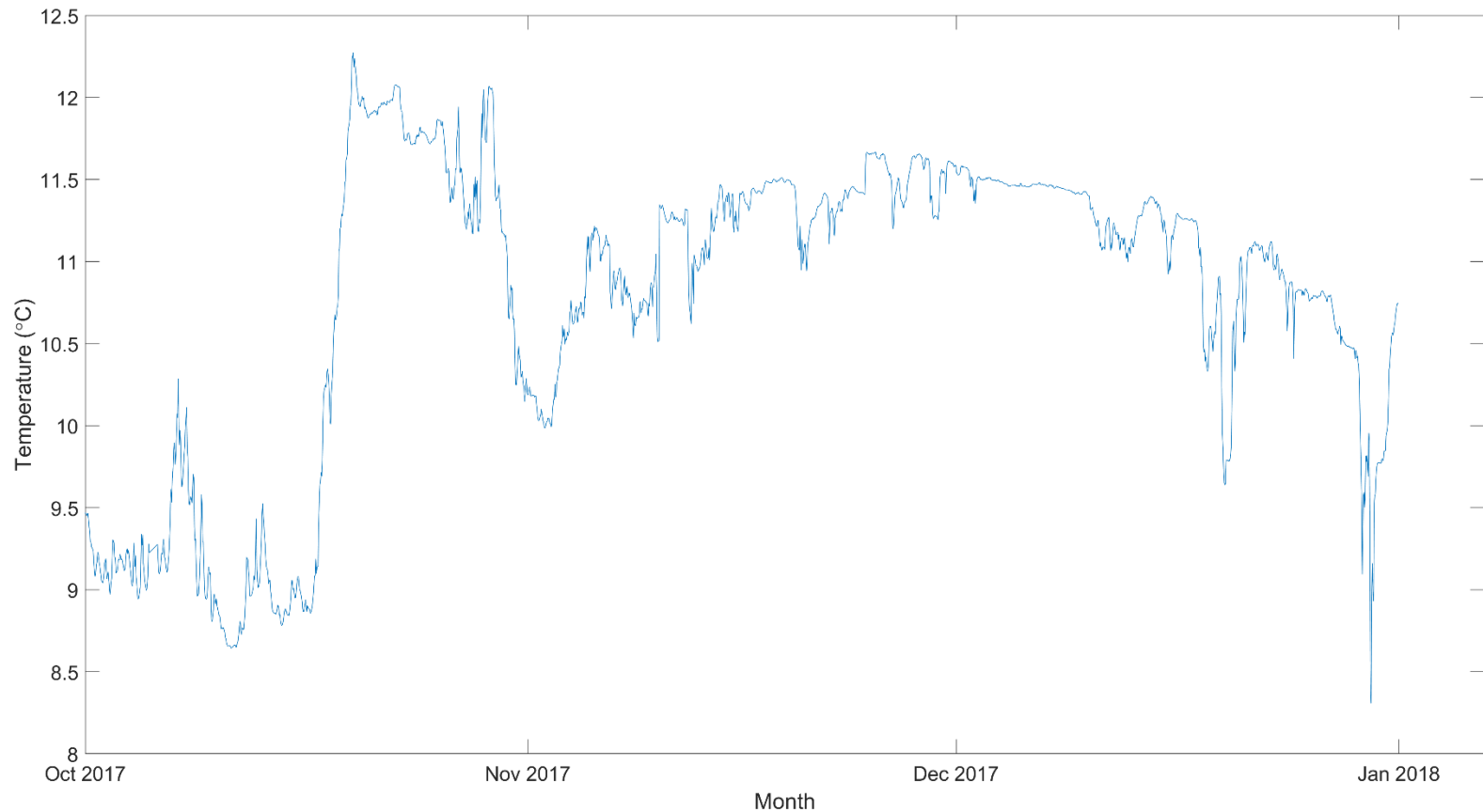
*pH*





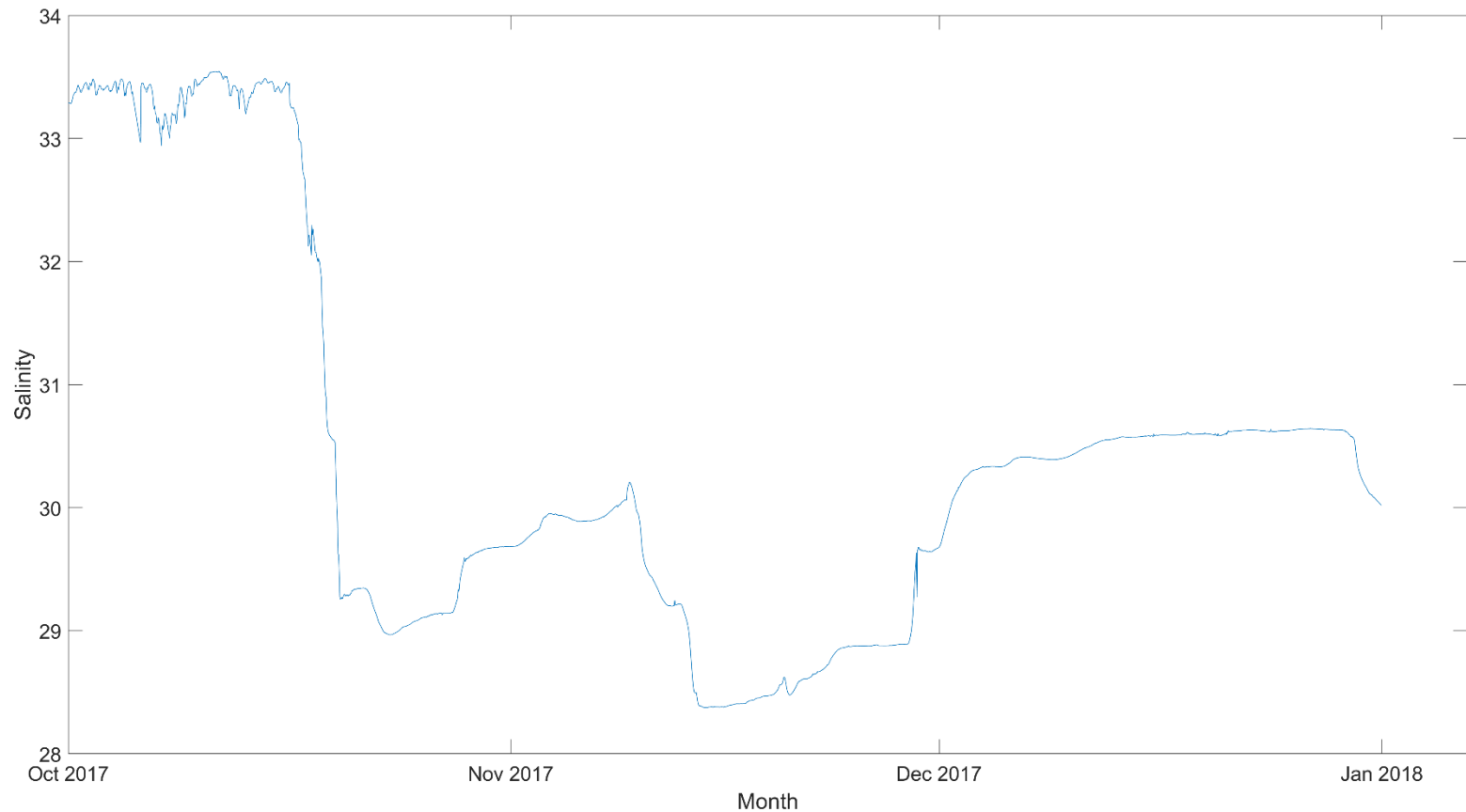
# Inshore mooring: CE06ISSM

## *Temperature*



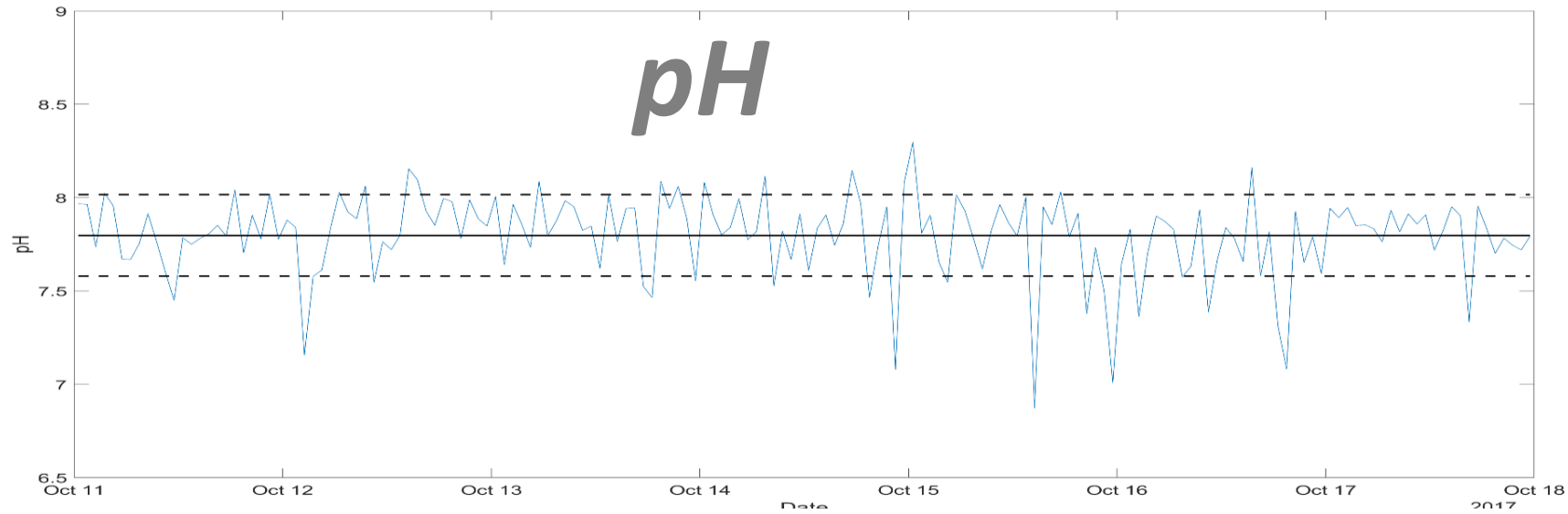
# Inshore mooring: CE06ISSM

## *Salinity*

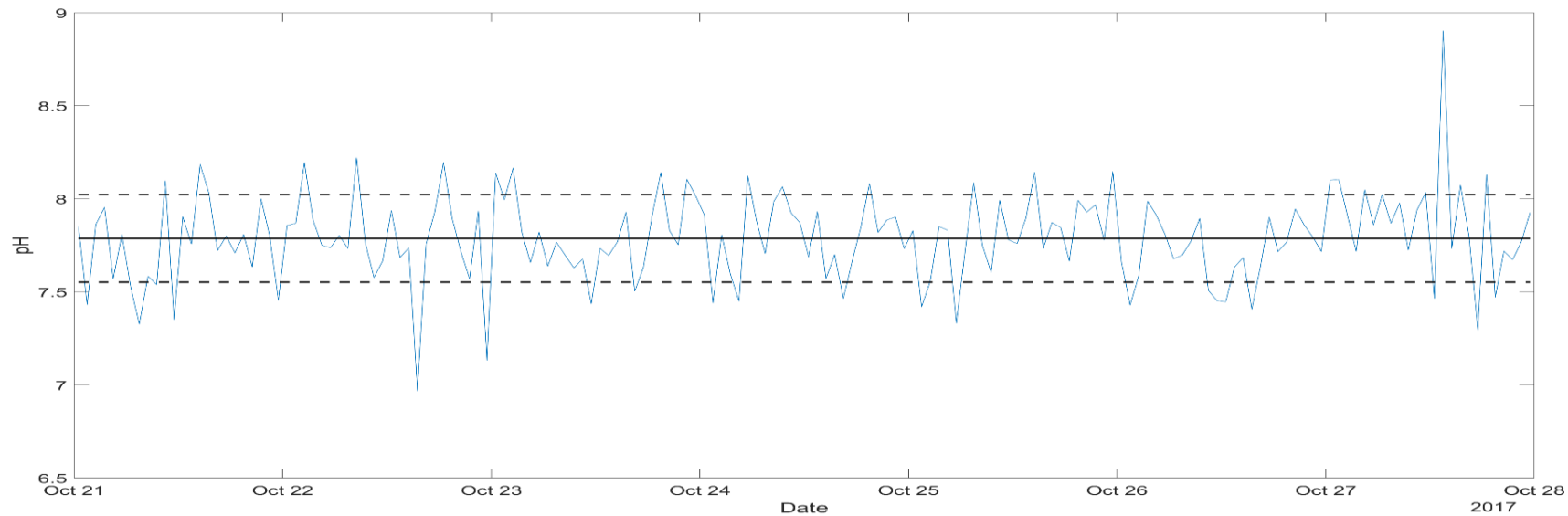


# Inshore mooring: CE06ISSM

Before River Plume Shift



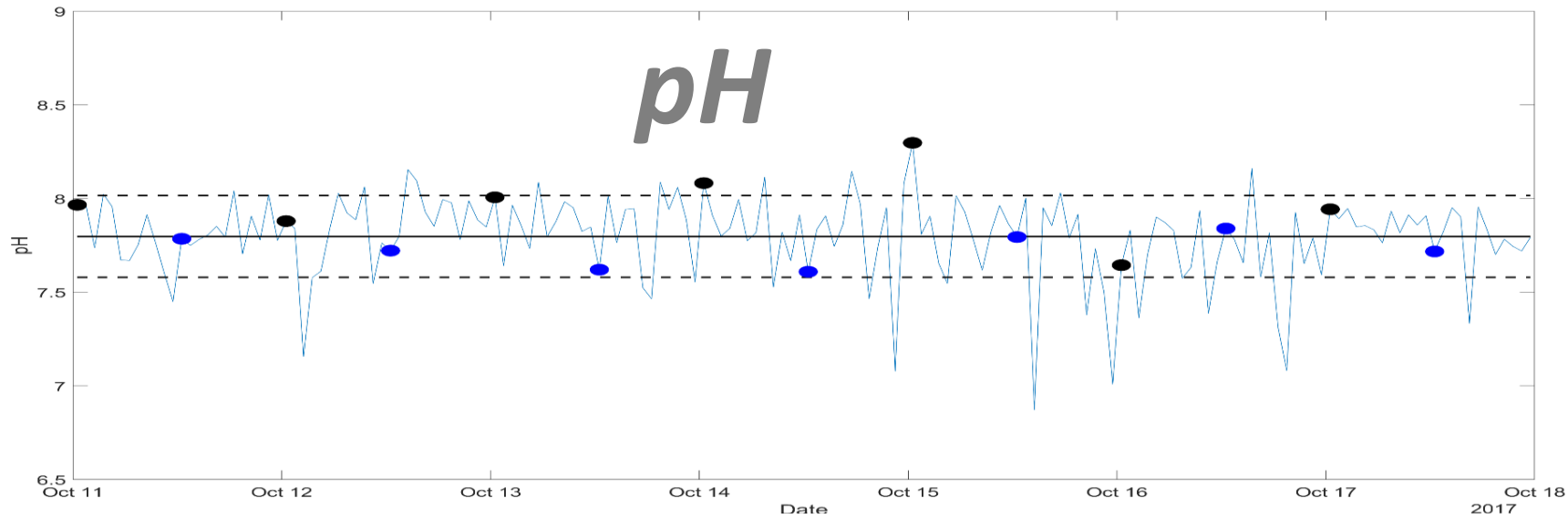
After River Plume Shift



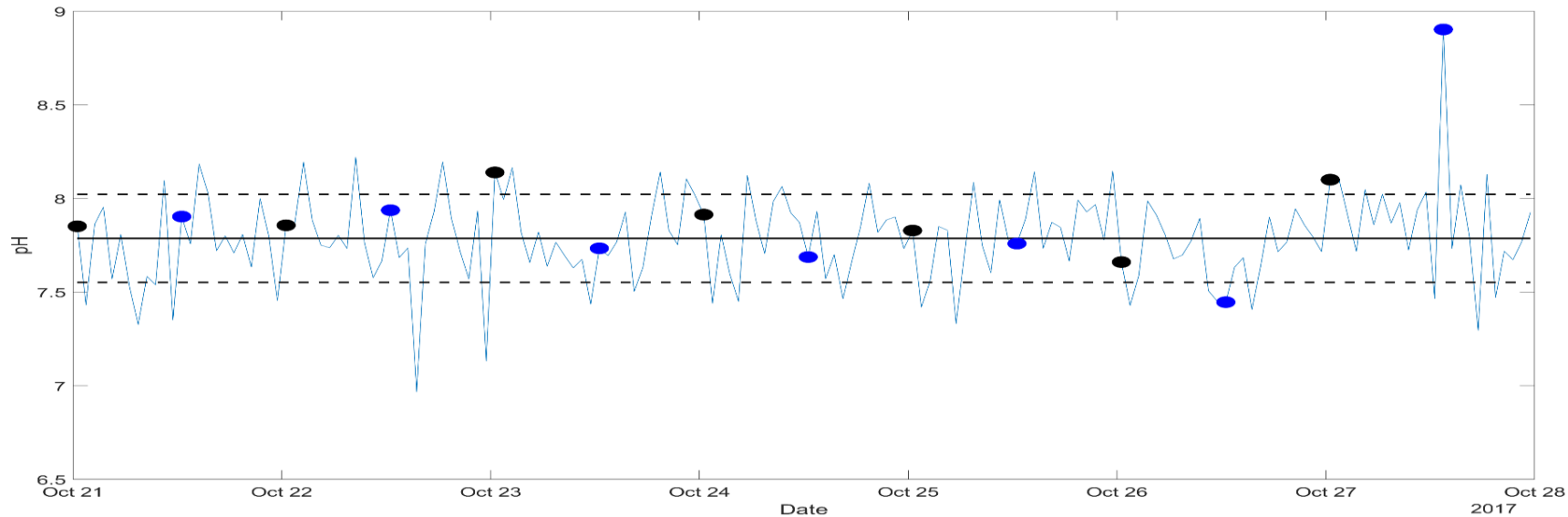


# Inshore mooring: CE06ISSM

Before River Plume Shift



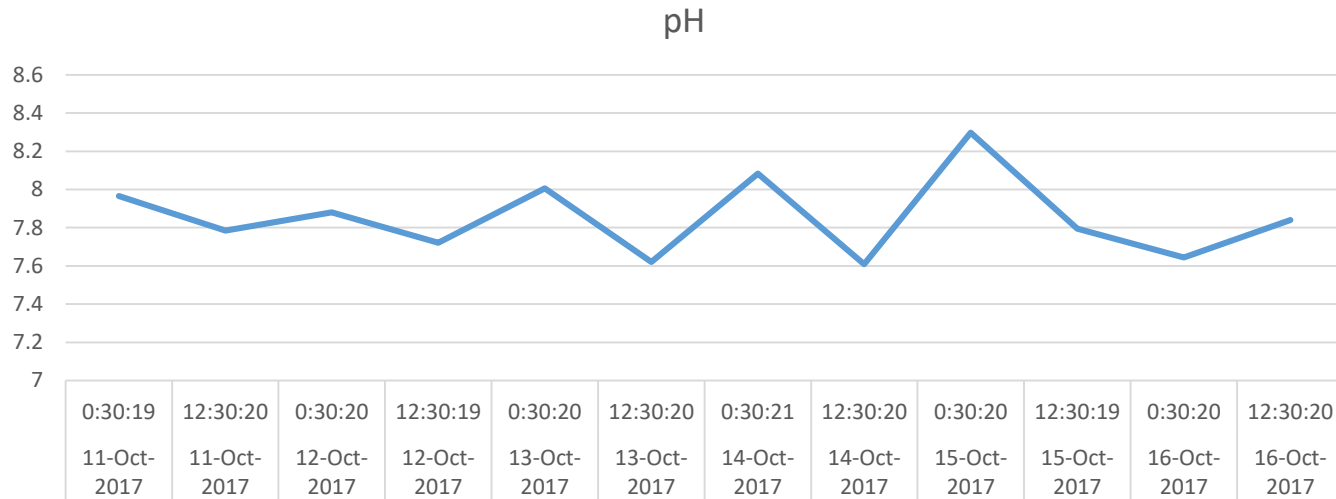
After River Plume Shift



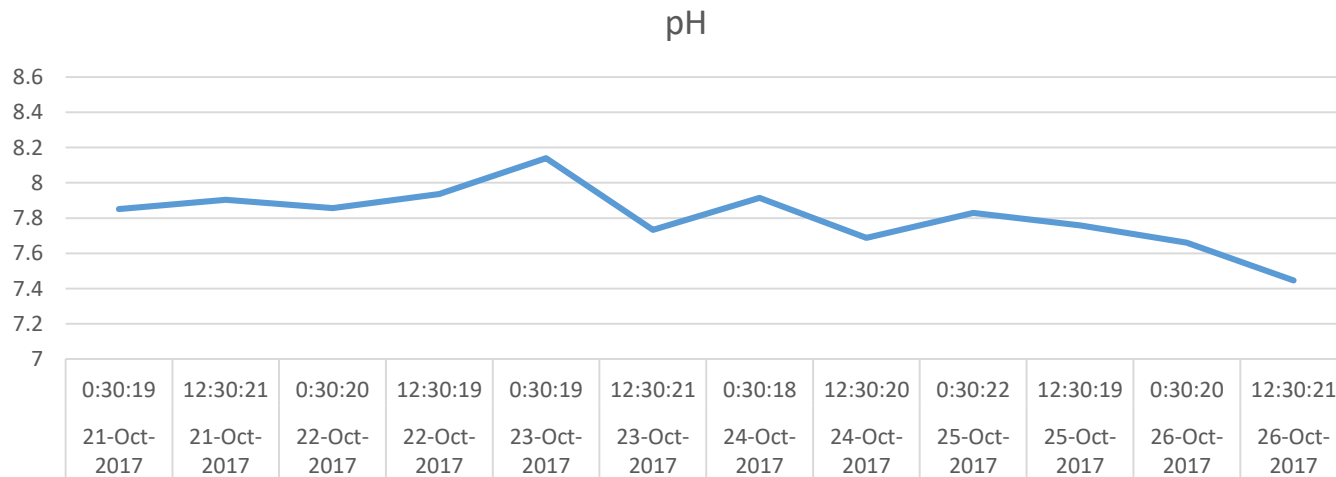
# Inshore mooring: CE06ISSM

## *Classroom Data Set*

Before River Plume Shift



After River Plume Shift



# Inshore mooring: CE06ISSM

## *Classroom Data Set*

| Date        | Time     | pH            | pHround  |  | Date        | Time     | pH            | pHround  |
|-------------|----------|---------------|----------|--|-------------|----------|---------------|----------|
| 11-Oct-2017 | 0:30:19  | 7.9663        | 8        |  | 21-Oct-2017 | 0:30:19  | 7.8516        | 7.9      |
| 11-Oct-2017 | 12:30:20 | 7.7851        | 7.8      |  | 21-Oct-2017 | 12:30:21 | 7.9033        | 7.9      |
| 12-Oct-2017 | 0:30:20  | 7.8795        | 7.9      |  | 22-Oct-2017 | 0:30:20  | 7.8568        | 7.9      |
| 12-Oct-2017 | 12:30:19 | 7.7217        | 7.7      |  | 22-Oct-2017 | 12:30:19 | 7.9372        | 7.9      |
| 13-Oct-2017 | 0:30:20  | 8.0066        | 8        |  | 23-Oct-2017 | 0:30:19  | 8.1391        | 8.1      |
| 13-Oct-2017 | 12:30:20 | 7.6202        | 7.6      |  | 23-Oct-2017 | 12:30:21 | 7.7337        | 7.7      |
| 14-Oct-2017 | 0:30:21  | 8.0824        | 8.1      |  | 24-Oct-2017 | 0:30:18  | 7.9139        | 7.9      |
| 14-Oct-2017 | 12:30:20 | 7.6091        | 7.6      |  | 24-Oct-2017 | 12:30:20 | 7.6873        | 7.7      |
| 15-Oct-2017 | 0:30:20  | 8.2973        | 8.3      |  | 25-Oct-2017 | 0:30:22  | 7.8286        | 7.8      |
| 15-Oct-2017 | 12:30:19 | 7.7945        | 7.8      |  | 25-Oct-2017 | 12:30:19 | 7.7591        | 7.8      |
| 16-Oct-2017 | 0:30:20  | 7.6443        | 7.6      |  | 26-Oct-2017 | 0:30:20  | 7.6602        | 7.7      |
| 16-Oct-2017 | 12:30:20 | 7.84          | 7.8      |  | 26-Oct-2017 | 12:30:21 | 7.4461        | 7.4      |
|             |          |               |          |  |             |          |               |          |
|             |          |               |          |  |             |          |               |          |
|             |          |               |          |  |             |          |               |          |
|             | Mean     | 7.853916667   | 7.85     |  |             | Mean     | 7.809741667   | 7.808333 |
|             | SD       | 0.206668148   | 0.219504 |  |             | SD       | 0.172306215   | 0.172986 |
|             | Range    | 7.6091:8.2973 | 7.6:8.3  |  |             | Range    | 7.4461:8.1391 | 7.4:8.1  |

<http://www.sartep.com/chem/chartsandtools/phconvert.cfm>



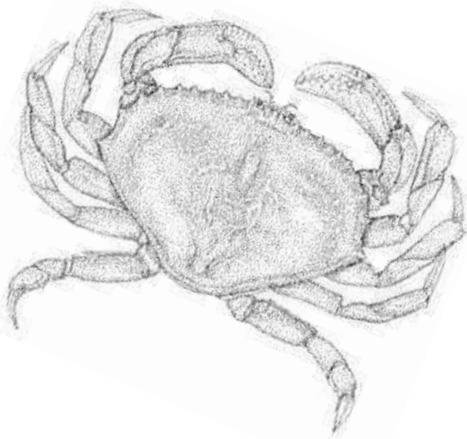
# Potential Classroom Applications

*“Simple, Local, Positive”*

Enhancing Mathematical Skills

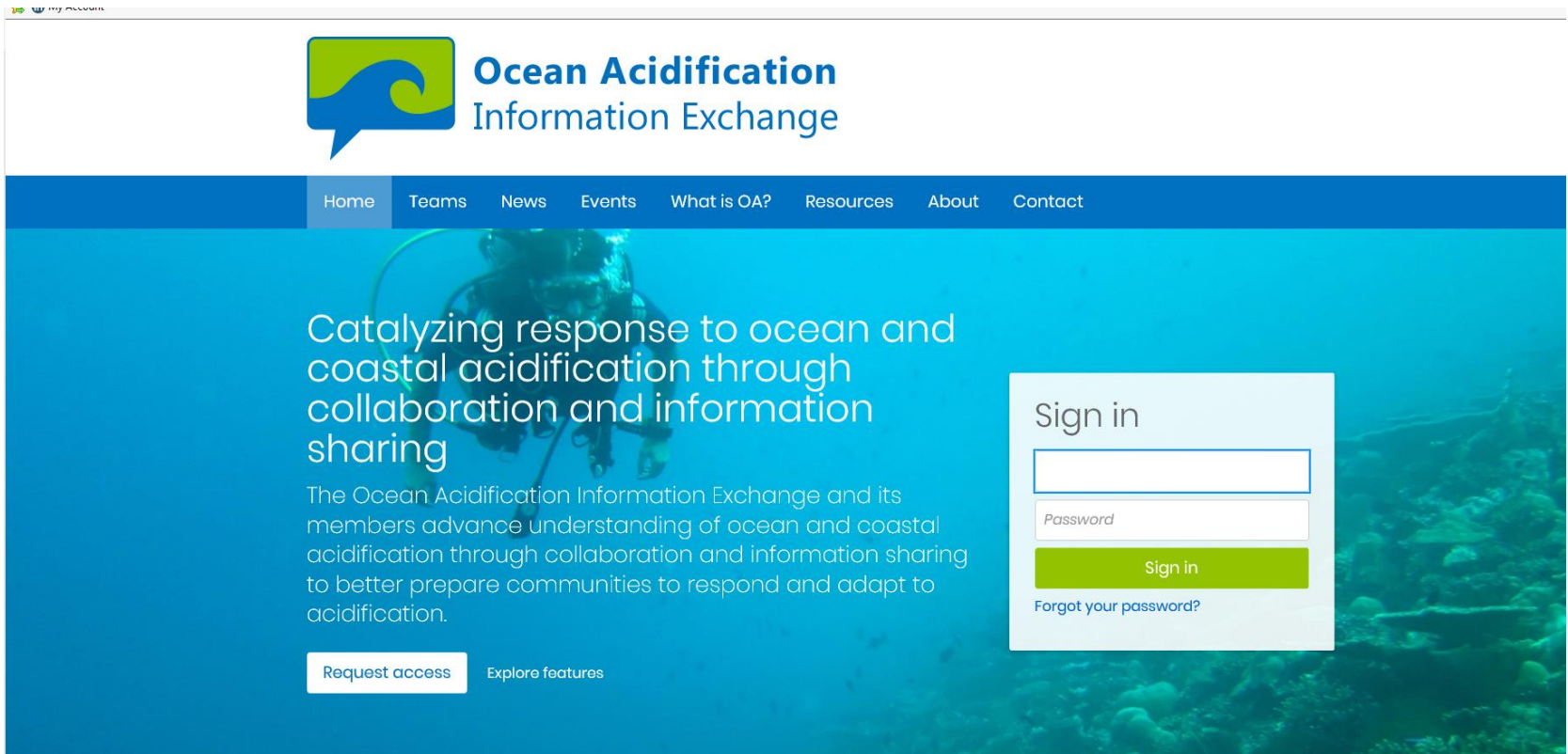
Graphing Skills and Data Interpretation

Links to Biology – research the pH stress limits of other species




# Supplemental Information

## *Community Forums*



The screenshot shows the homepage of the Ocean Acidification Information Exchange. At the top left is a logo consisting of a green speech bubble with a blue wave inside. To its right is the text "Ocean Acidification Information Exchange". Below this is a blue navigation bar with white links: Home, Teams, News, Events, What is OA?, Resources, About, and Contact. The main content area has a blue background with an underwater image of a diver. On the left, the text reads: "Catalyzing response to ocean and coastal acidification through collaboration and information sharing". Below this is a paragraph: "The Ocean Acidification Information Exchange and its members advance understanding of ocean and coastal acidification through collaboration and information sharing to better prepare communities to respond and adapt to acidification." At the bottom left are two buttons: "Request access" and "Explore features". On the right is a "Sign in" box with a text input field, a "Password" label, another text input field, a green "Sign in" button, and a link "Forgot your password?".

my account

 **Ocean Acidification**  
Information Exchange

Home Teams News Events What is OA? Resources About Contact

Catalyzing response to ocean and coastal acidification through collaboration and information sharing

The Ocean Acidification Information Exchange and its members advance understanding of ocean and coastal acidification through collaboration and information sharing to better prepare communities to respond and adapt to acidification.

Request access Explore features

Sign in

Password

Sign in

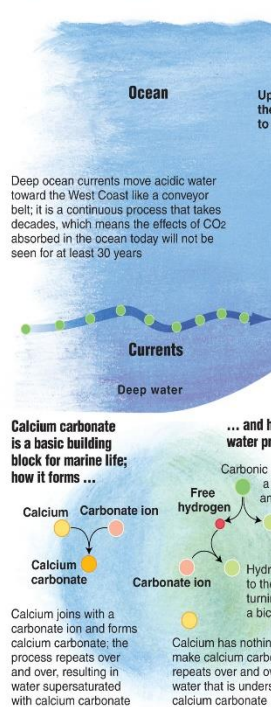
[Forgot your password?](#)

<https://www.oainfoexchange.org/index.html>

# Supplemental Information

## One page graphics

### How ocean acidification affects the West Coast



**West Coast** Upwelling happens when

- 1 Wind blowing across ocean surface pushes surface water away from the West Coast shore
- 2 Deep, cold water is drawn up to replace the windblown water

Surface water

### WHAT IS OCEAN ACIDIFICATION?

**HOW DOES IT WORK?**  
The ocean absorbs lots of CO<sub>2</sub> from the atmosphere.

Different things happen to CO<sub>2</sub> once it's in the ocean. Some of the CO<sub>2</sub> combines with water to form carbonic acid, which then breaks apart into hydrogen ions and bicarbonate ions.

**HISTORICAL**

**WHAT'S LIKELY TO HAPPEN?**  
Evidence about the effects of ocean acidification is uncertain about the extent of some likely scenarios.

It will be more difficult to predict the effects of ocean acidification on some organisms. Some organisms, like certain sea grasses, might benefit from ocean acidification.

### WHAT CAN WE DO ABOUT IT?

We can't stop ocean acidification entirely, but we can do our best to mitigate the impacts and protect those affected.

1. As individuals, we can reduce our carbon footprint and buy sustainable products.

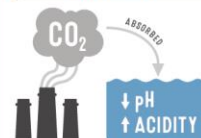
2. As societies, we can support research and monitoring and force change on governments and industries.

By 2100, the pH of the ocean will probably be 7.7.

## CARBON DIOXIDE AND OCEAN ACIDIFICATION

Climate change is a much-discussed effect of rising carbon dioxide levels, but they can also affect our oceans. This graphic takes a look at how.

### THE BASICS



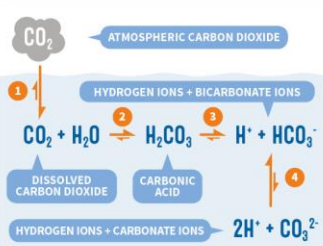
Atmospheric carbon dioxide has increased by 40% from pre-industrial levels due to burning of fossil fuels and deforestation. Ocean acidification occurs when atmospheric carbon dioxide dissolves in seawater.

| PRE-INDUSTRIAL | 2013           | 2100           |
|----------------|----------------|----------------|
| pH 8.2         | pH 8.1         | pH 7.7         |
| 100% SATURATED | 100% SATURATED | 100% SATURATED |

Acidity and alkalinity are measured on the logarithmic pH scale. A pH over 7 is alkaline; below 7 is acidic. A change of one unit represents a tenfold change in acidity or alkalinity. Seawater is alkaline, but average ocean surface pH has dropped by 0.1 since pre-industrial times, a 25% increase in acidity.

### THE CHEMISTRY OF OCEAN ACIDIFICATION

Atmospheric carbon dioxide dissolves in seawater (1) and reacts with the water to form carbonic acid (2). Carbonic acid dissociates (splits up) into its ions (3); hydrogen ions produced by this dissociation increase acidity, lowering seawater pH. Increased atmospheric carbon dioxide ultimately produces more hydrogen ions, lowering pH further.



Hydrogencarbonate ions can dissociate further to form carbonate ions (4) but this is less favoured. Consequently hydrogencarbonate ions are the most abundant form of inorganic carbon in the oceans. Calcium carbonate can also react with dissolved carbon dioxide in seawater to form more hydrogencarbonate ions (5).



### THE EFFECTS OF OCEAN ACIDIFICATION

#### 1 EFFECT ON CALCIFYING ORGANISMS AND CORAL



As ocean pH drops, hydrogen ions react with carbonate ions. Calcifying organisms such as clams, oysters and crustaceans use the carbonate ions from seawater to make shells. When calcium carbonate is undersaturated in seawater, their shells can start dissolving. Coral skeletons can also be affected.

#### 2 EFFECT ON FOOD WEBS AND FISHING



#### 3 EFFECTS ON ANIMAL CHEMICAL SIGNALLING



Many marine species use chemical signals for detecting predators, settlement, and reproduction. Ocean acidification can alter signalling molecules, which could in turn have potentially detrimental effects on a number of different species.



© Andy Brunning/Compound Interest 2017 - [www.compoundchem.com](http://www.compoundchem.com) | Twitter: @compoundchem | FB: [www.facebook.com/compoundchem](https://www.facebook.com/compoundchem)  
This graphic is shared under a Creative Commons Attribution-NonCommercial-NoDerivatives licence.





# Supplemental Information

## *NOAA OA Centers*



<https://oceanacidification.noaa.gov/AboutUs/EducationOutreach/TabId/2994/PID/14968/evl/0/CategoryID/208/CategoryName/education-outreach/Default.aspx>

# Supplemental Information

## *Additional Data Portals*

<https://sos.noaa.gov/datasets/ocean-acidification-surface-ph/>

[https://www.nodc.noaa.gov/oceanacidification/stewardship/data\\_portal.html](https://www.nodc.noaa.gov/oceanacidification/stewardship/data_portal.html)

[http://nvs.nanoos.org/Explorer?action=overlay:liveocean\\_temp](http://nvs.nanoos.org/Explorer?action=overlay:liveocean_temp)

<http://www.nanoos.org/products/j-scope/forecasts.php>

*Stay tuned for the release of the PCC West Coast Portal in early 2019*

*For additional information email:*

*charlotte.m.regulawhitefield@state.or.us*