Ocean Acidification: what is it & what we are observing along our coast

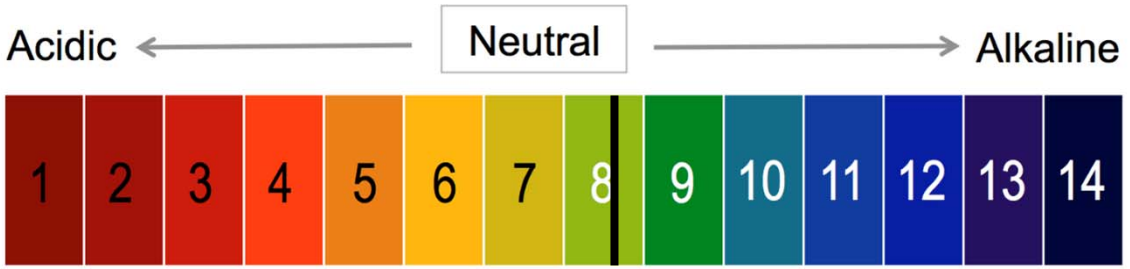
Wiley Evans

May 28, 2020

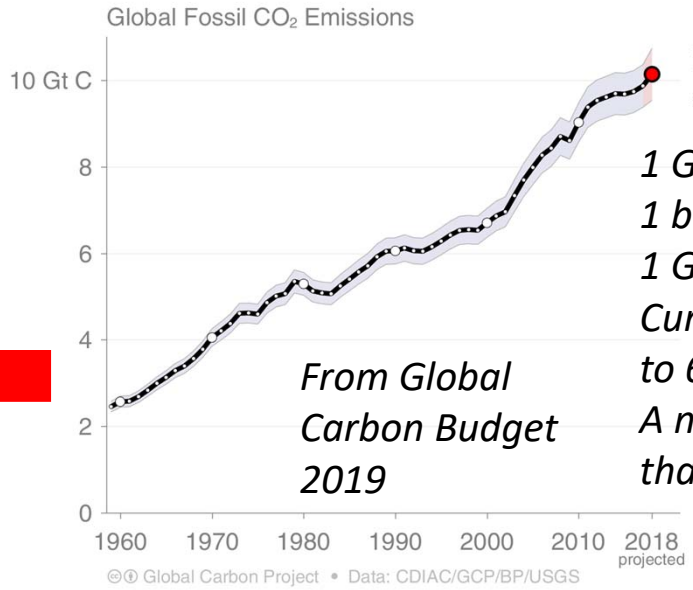
Hakai

Ocean Acidification is not:

$$pH = -\log_{10}[H^+]$$

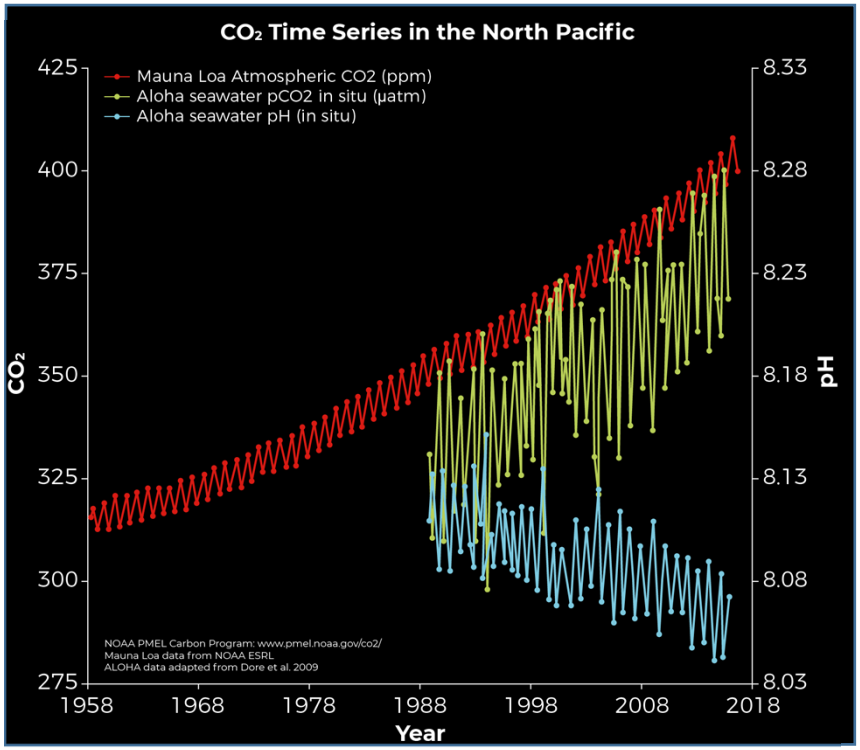


Ocean Acidification (OA) is:

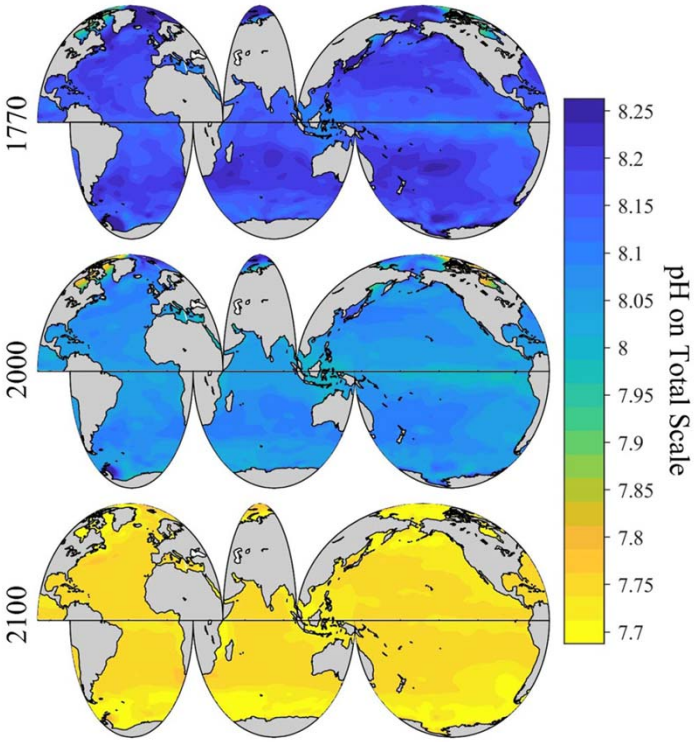


From Global Carbon Budget 2019

1 Gt C = 10^9 tons
1 blue whale = 180 tons
1 Gt C = 6 million blue whales
Current emissions equivalent to 60 million blue whales
A number of blue whales that could circle Earth 45x



From Ocean Observing System Report Card 2019



From Jiang et al 2019

OA also is:

A direct reaction with carbonate

$$CO_2 + CO_3^{2-} + H_2O \leftrightarrow 2HCO_3^-$$

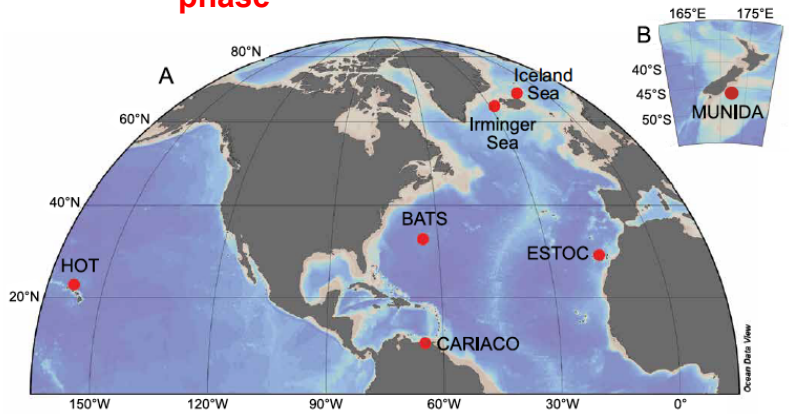
$$Ca^{2+} + CO_3^{2-} \leftrightarrow CaCO_3$$

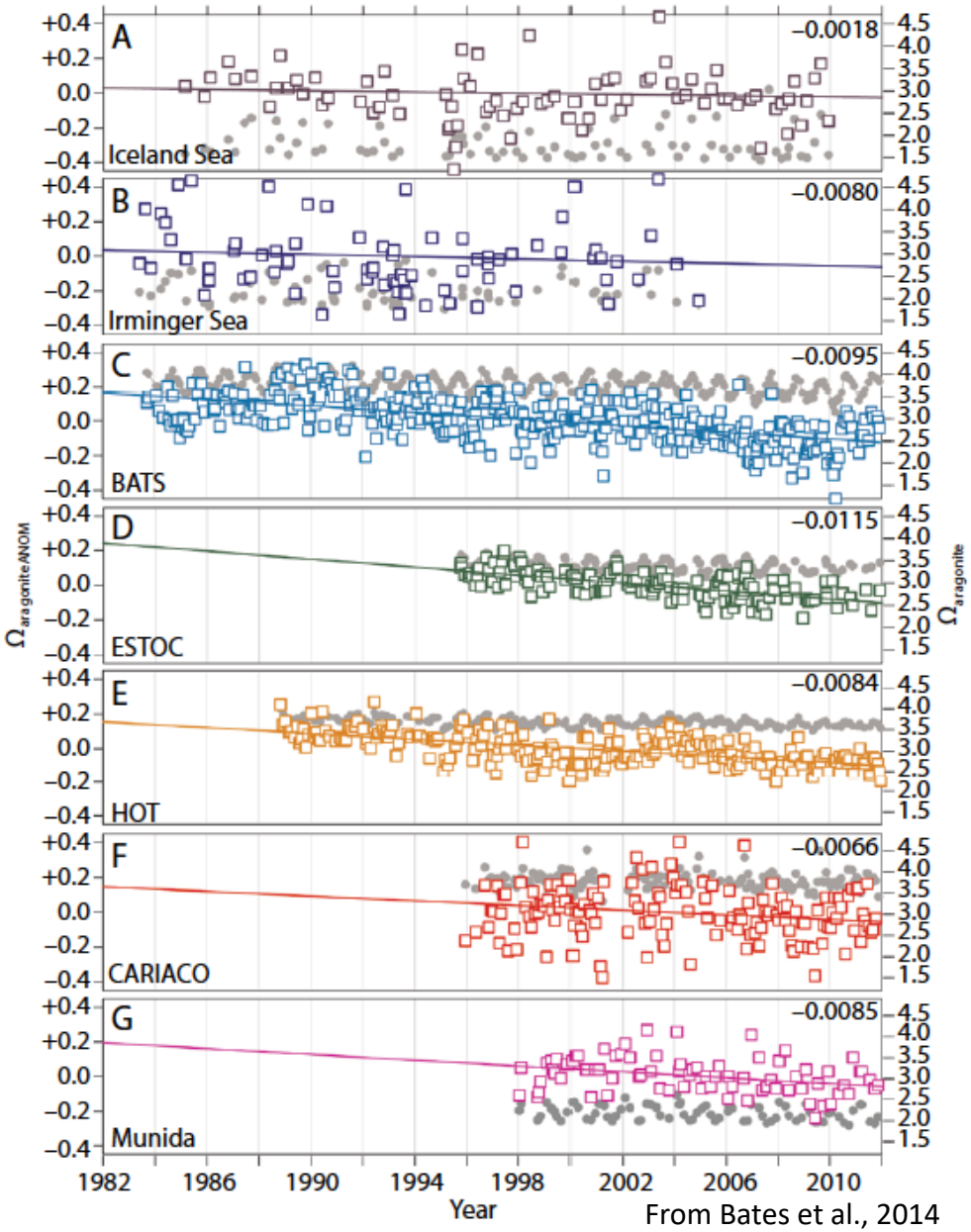
Saturation State

$$\Omega_{phase} = \frac{[Ca^{2+}][CO_3^{2-}]}{K^*_{sp,phase}}$$

Ω_{phase} > 1 = precipitate

Ω_{phase} < 1 = dissolve



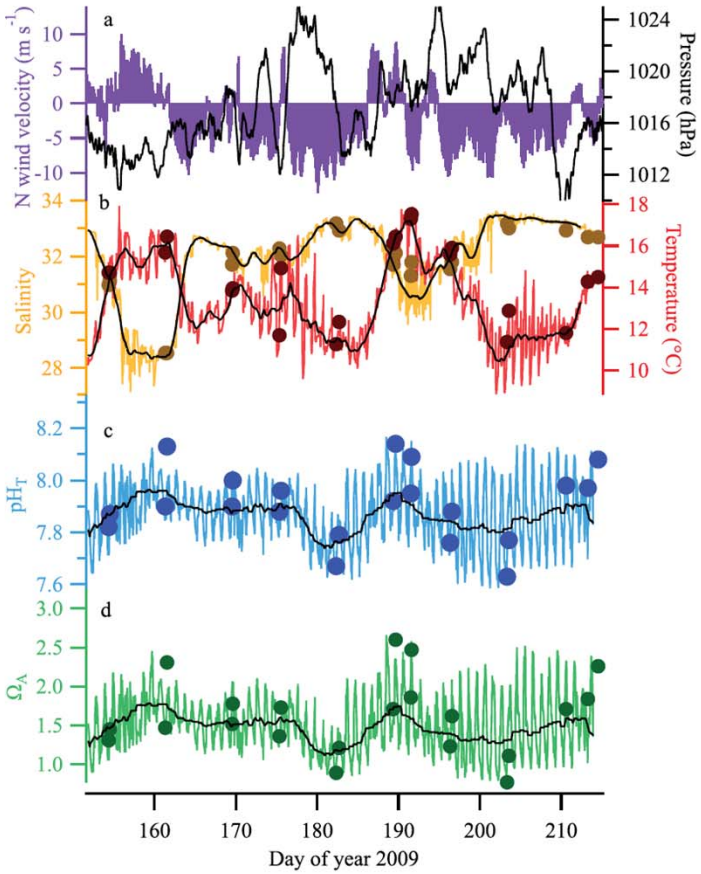


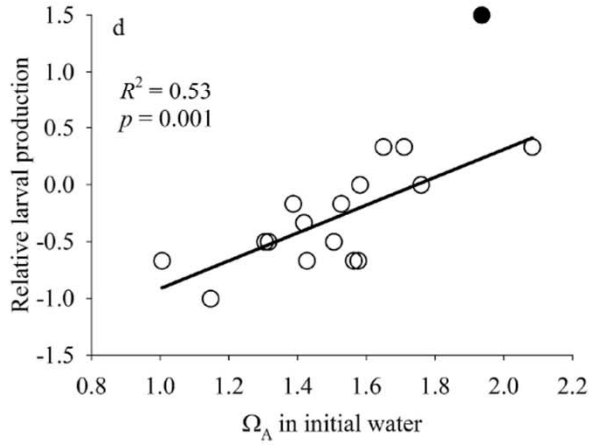
From Bates et al., 2014

Impacts of Coastal Acidification on the Pacific Northwest Shellfish Industry and Adaptation Strategies Implemented in Response

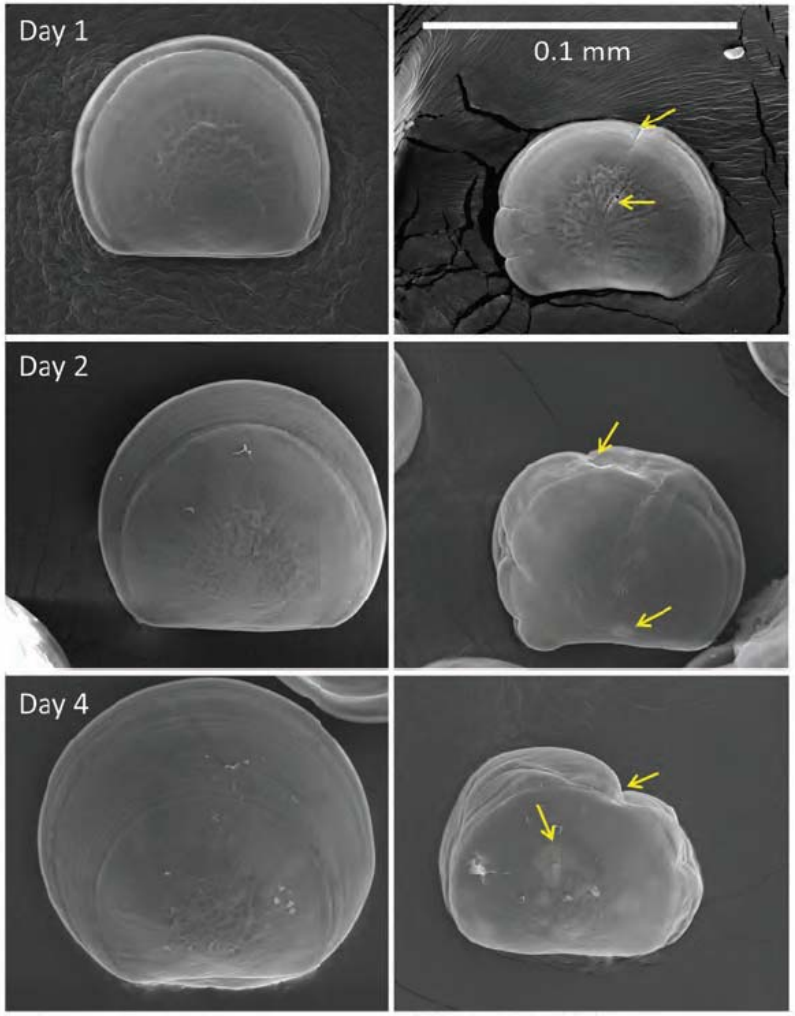
By Alan Barton, George G. Waldbusser, Richard A. Feely, Stephen B. Weisberg, Jan A. Newton, Burke Hales, Sue Cudd, Benoit Eudeline, Chris J. Langdon, Ian Jefferds, Teri King, Andy Suhrbier, and Karen McLaughlin

Photo credit:





Pacific Oyster post-fertilization



Images from Washington State Blue Ribbon Panel on Ocean Acidification

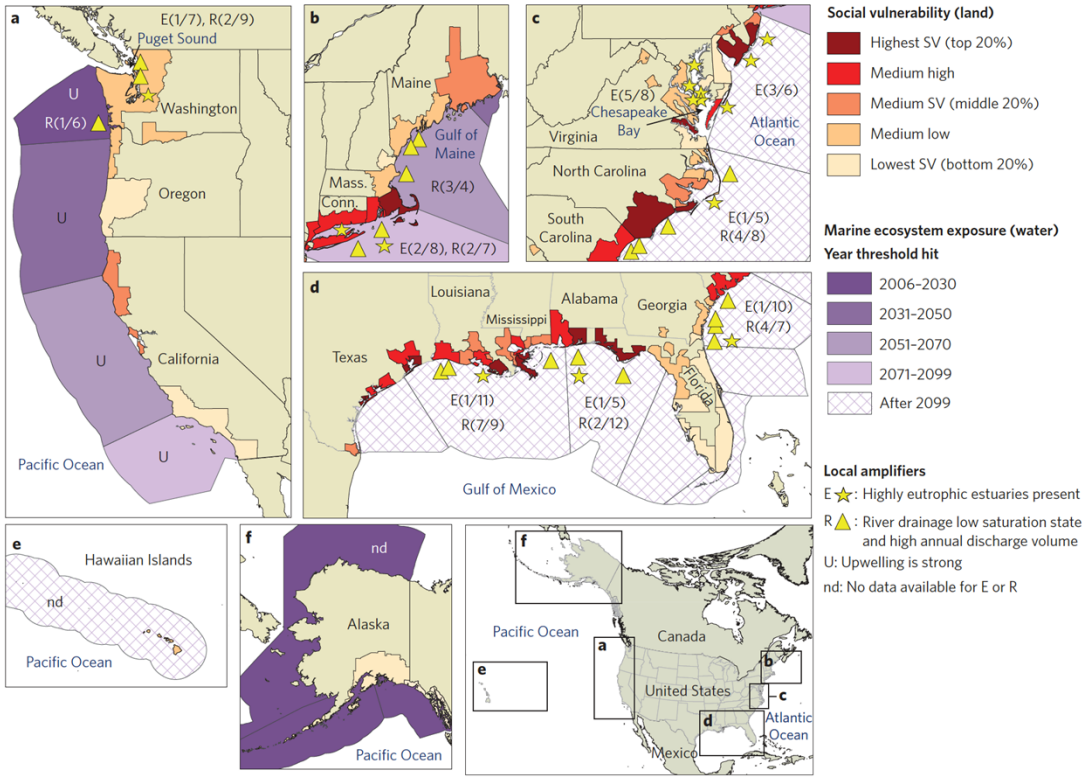
nature climate change

PERSPECTIVE

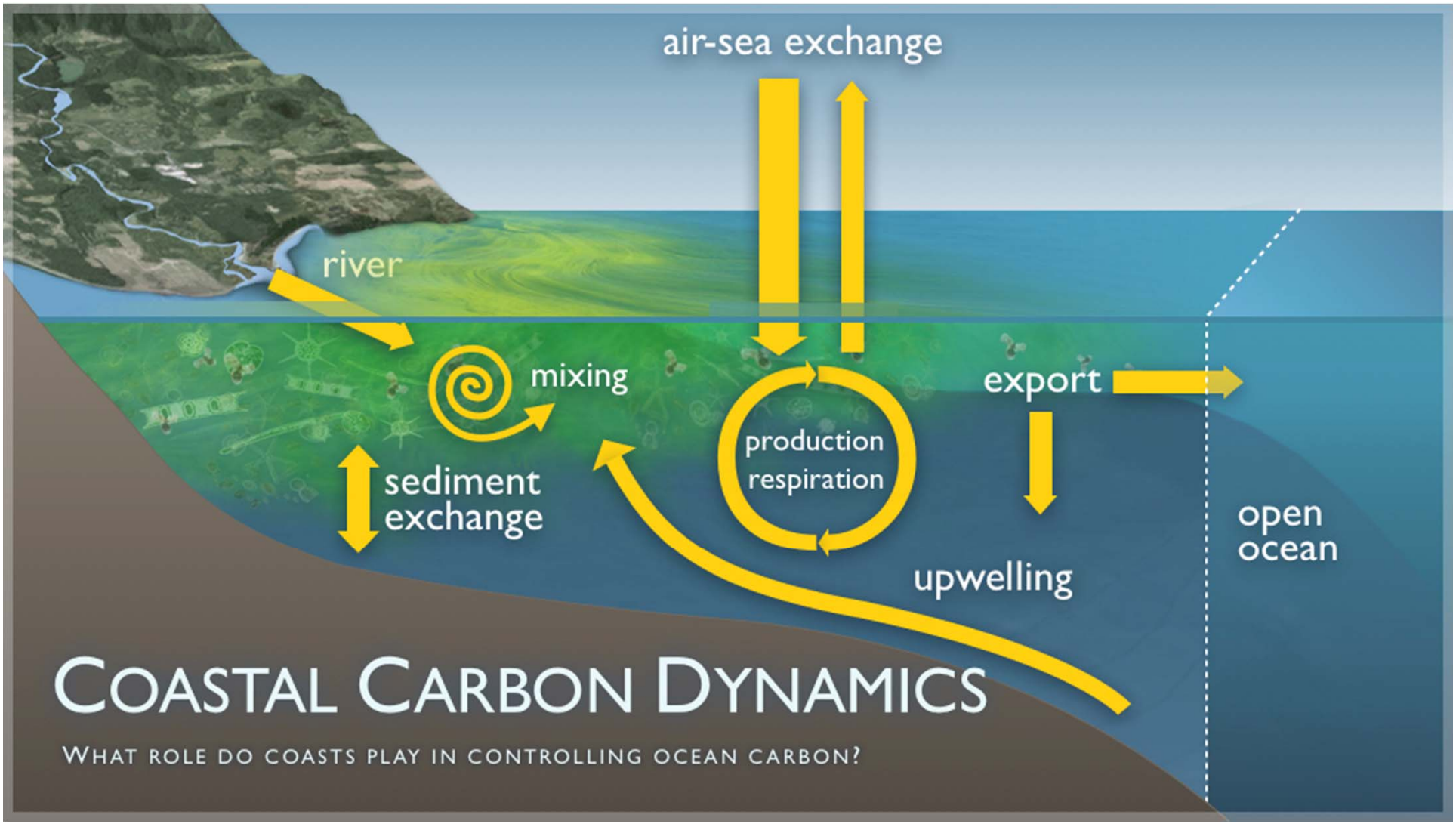
PUBLISHED ONLINE: 23 FEBRUARY 2015 | DOI: 10.1038/NCLIMATE2508

Vulnerability and adaptation of US shellfisheries to ocean acidification

Julia A. Ekstrom[1*†], Lisa Suatoni[2], Sarah R. Cooley[3], Linwood H. Pendleton[4,5], George G. Waldbusser[6], Josh E. Cinner[7], Jessica Ritter[8], Chris Langdon[9], Ruben van Hooidonk[10], Dwight Gledhill[11], Katharine Wellman[12], Michael W. Beck[13], Luke M. Brander[14], Dan Rittschof[8], Carolyn Doherty[8], Peter E. T. Edwards[15,16] and Rosimeiry Portela[17]

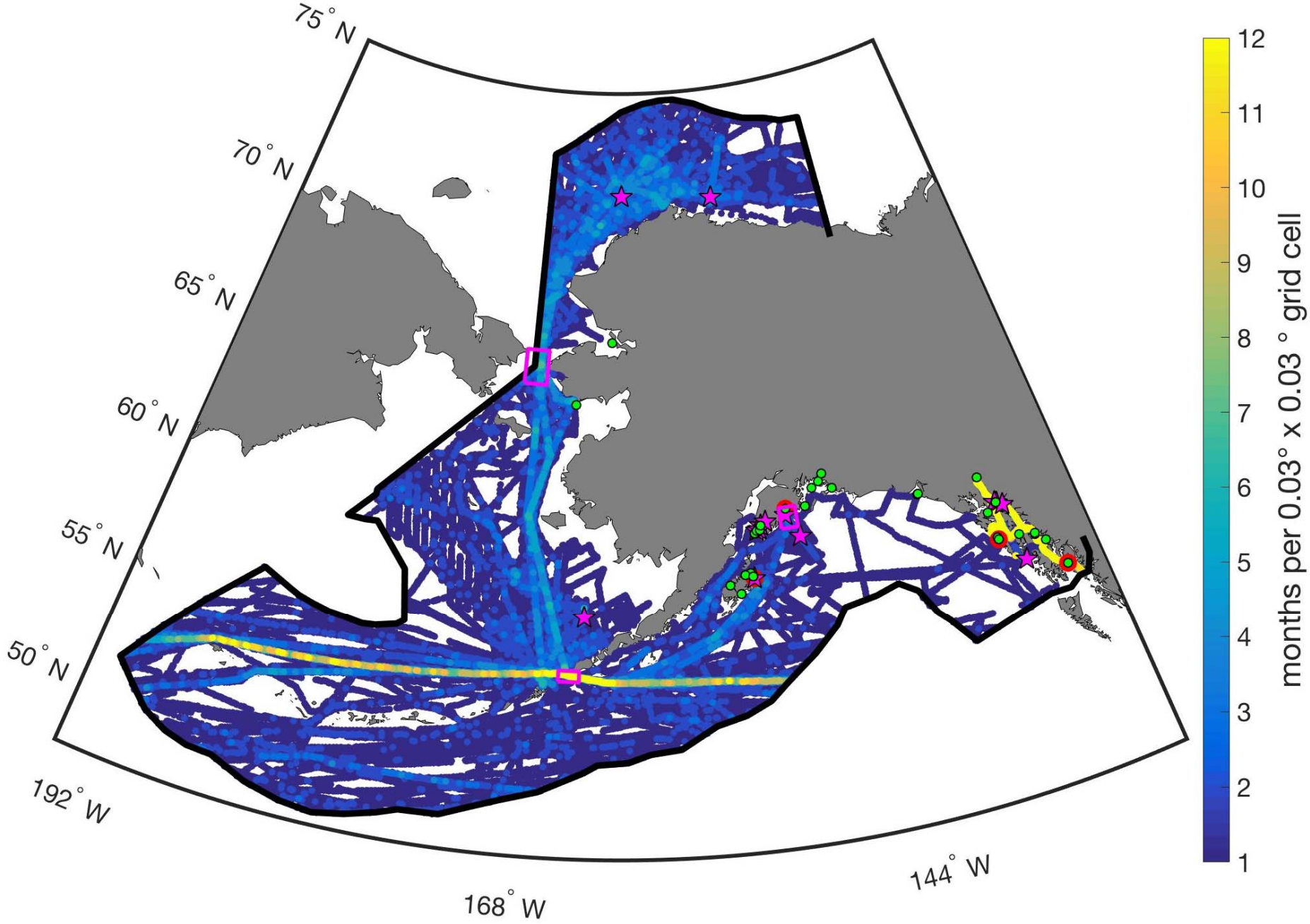


Complexity makes observing the coastal zone challenging

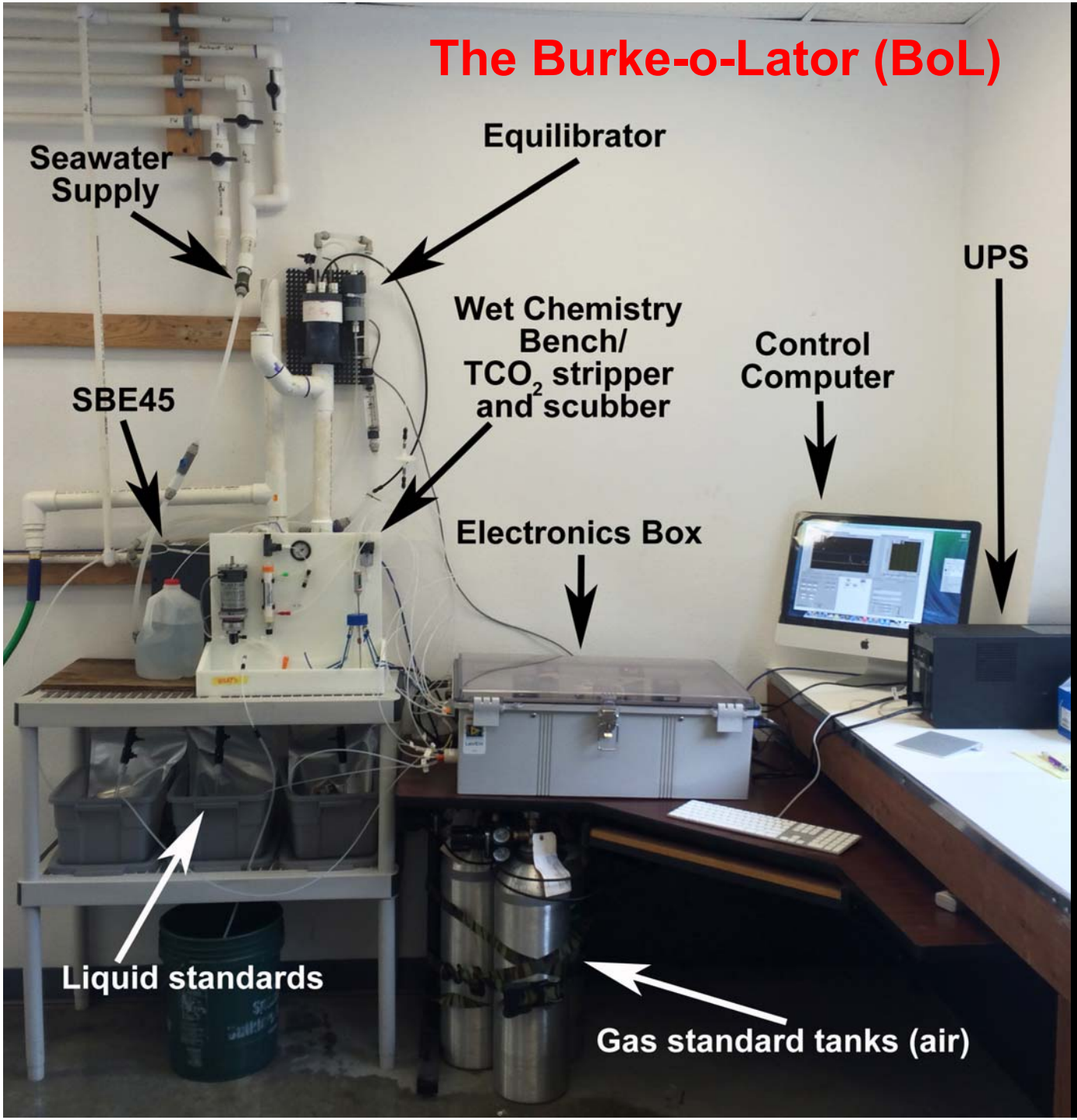


From NOAA PMEL Carbon Program

Observations within Alaskan EEZ



The Burke-o-Lator (BoL)



Measurement Suite:

(1) Total dissolved inorganic carbon; TCO_2

(2) Carbon dioxide partial pressure; pCO_2

(3) Temperature

(4) Salinity

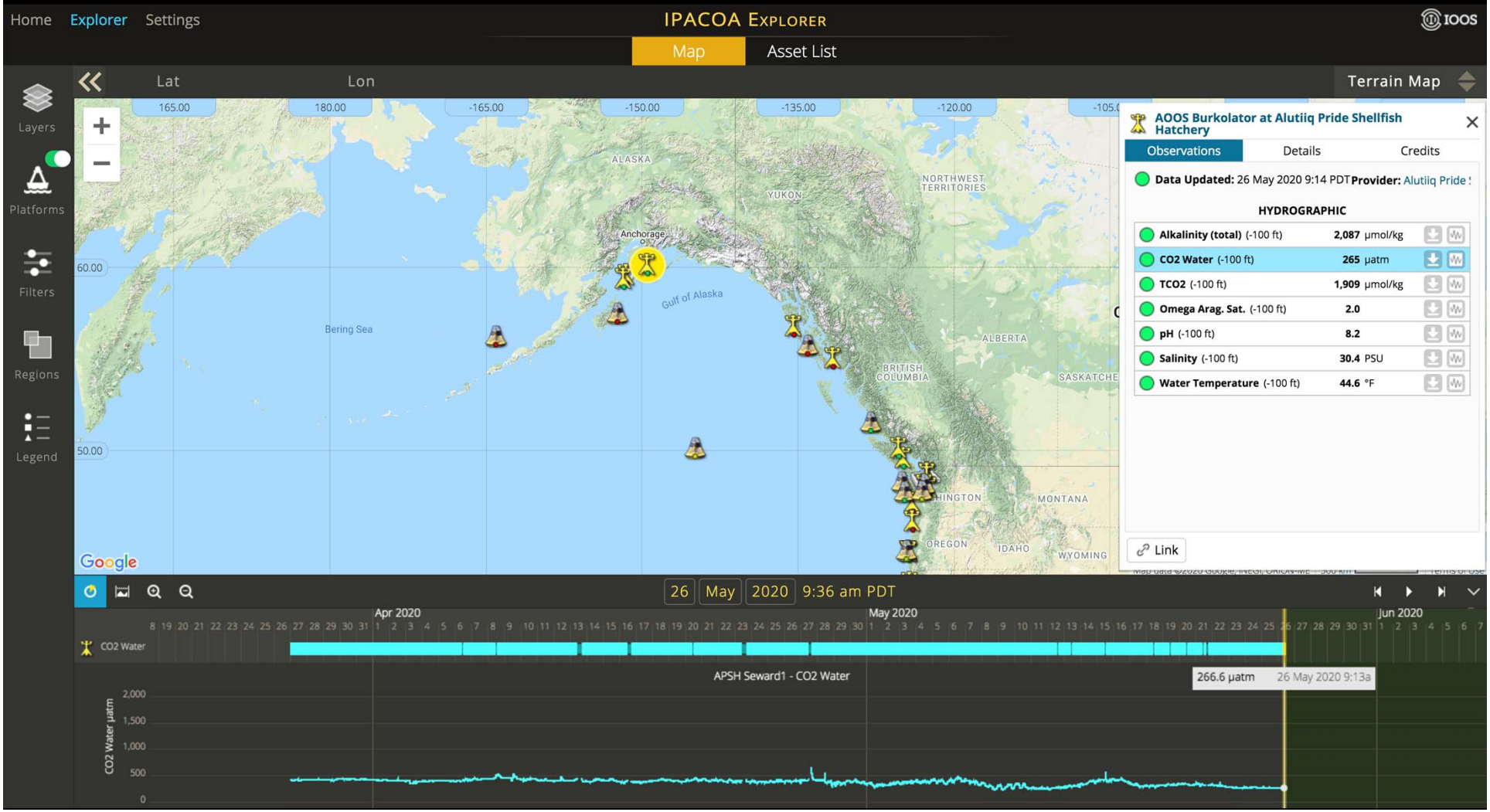
Extras: e.g. O_2, Chl

From 1, 2, 3, and 4, calculate pH and Ω

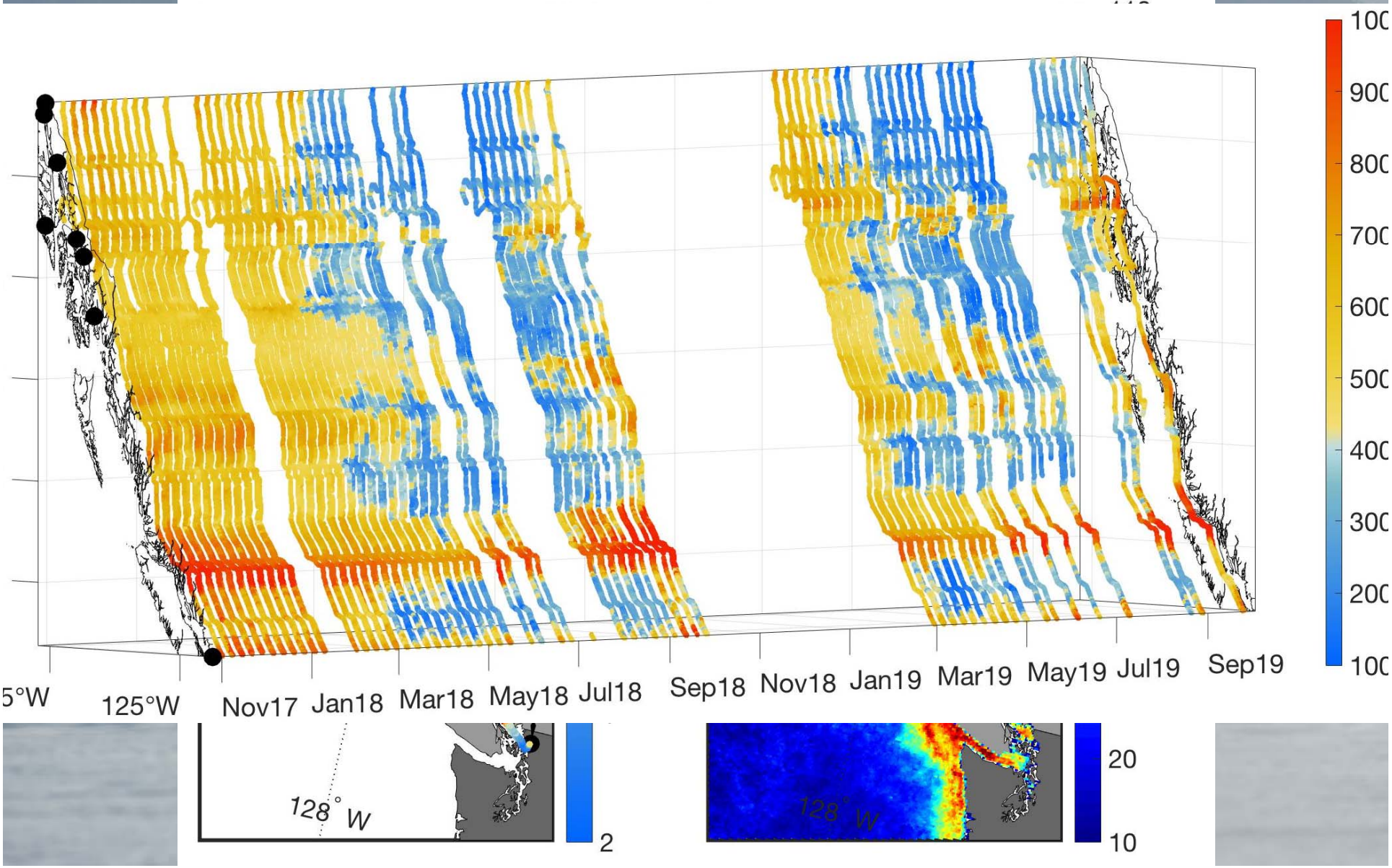
“Putting an IOOS buoy in the water is like putting headlights on a car. It lets us see changing water conditions in real time.”

- **Mark Wiegardt, WCSH**

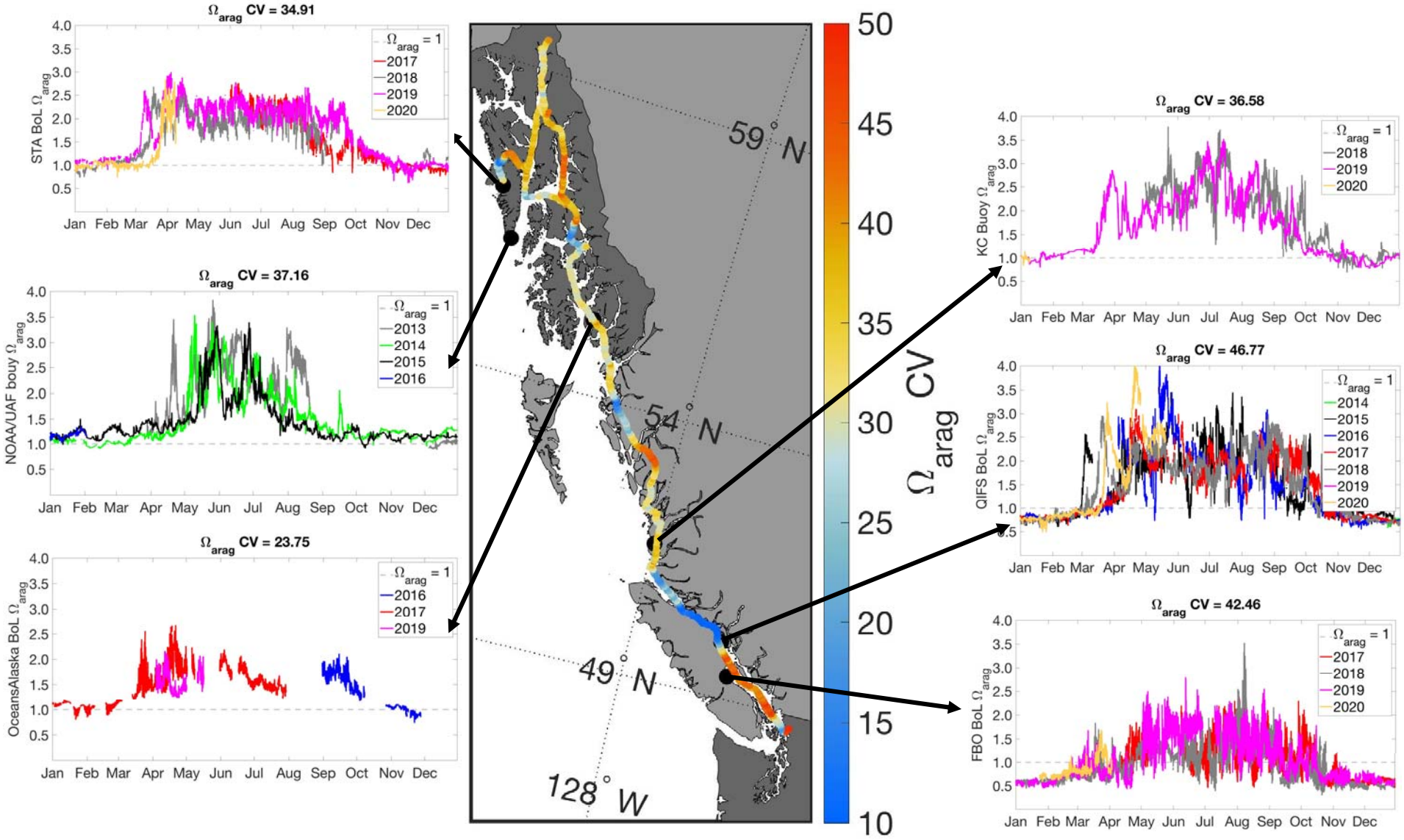
Regional (IPACOA): http://www.ipacoa.org/Explorer



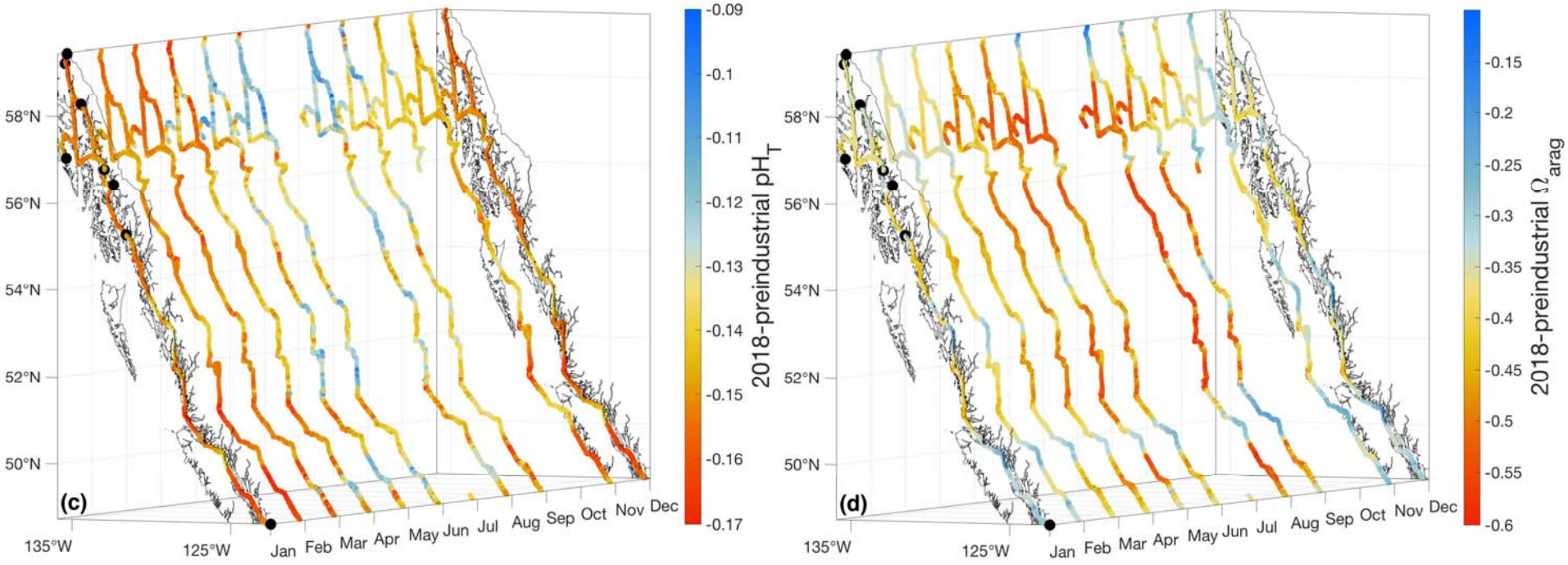
Measurements from the Alaska Marine Highway System M/V *Columbia*



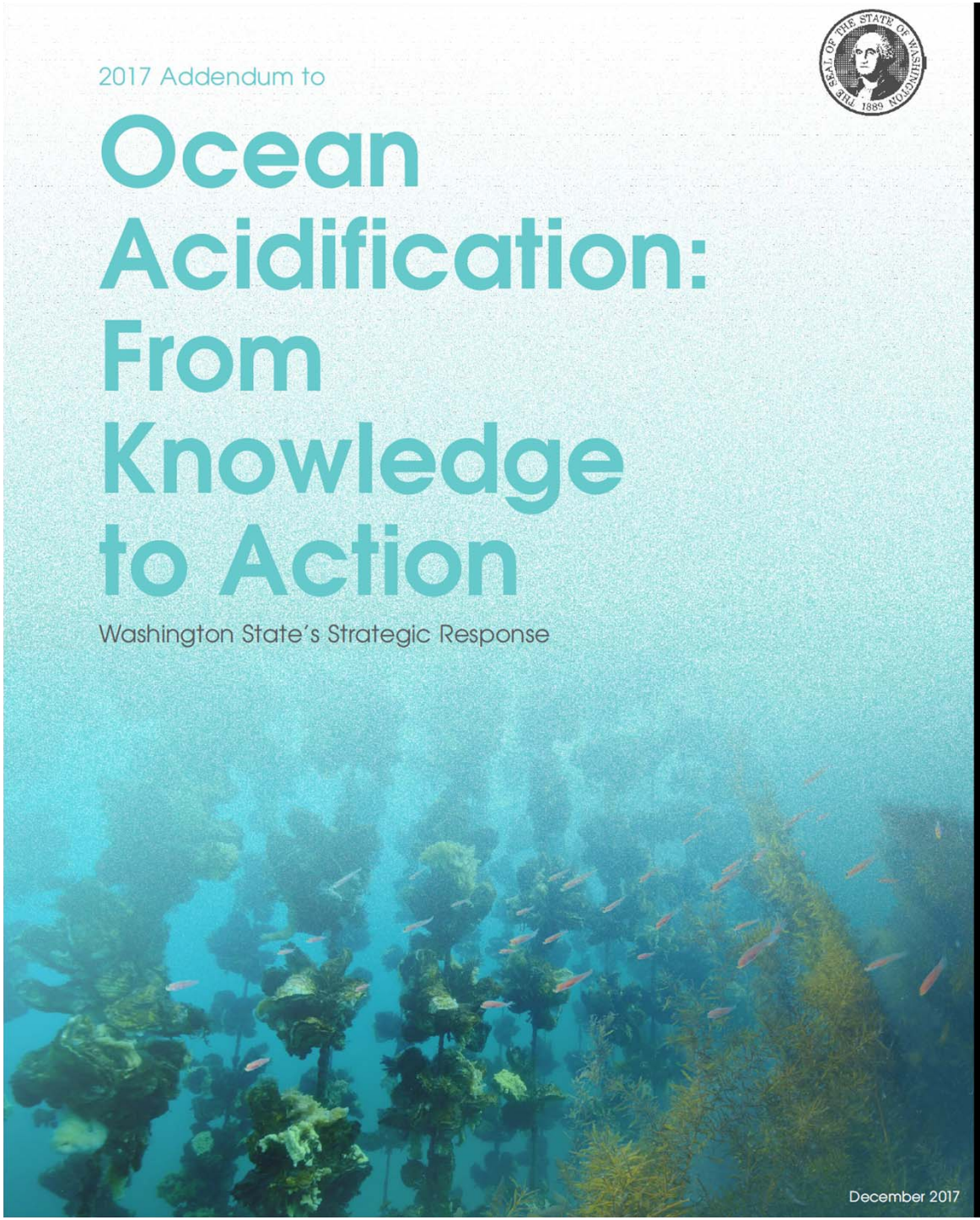
Combining datasets to evaluate variability



Estimate how conditions have changed since Pre-Industrial



Δ pH > in winter; $\Delta\ \Omega_{arag}$ greater in summer



Strategy 1: Reduce CO_2 emissions

Strategy 2: Reduce local land-based contributions to OA

Strategy 3: Increase ability to adapt and remediate the impacts of OA

Strategy 4: Invest in ability to monitor & investigate the effects of OA

Strategy 5: Inform / educate / engage stakeholders

Strategy 6: Maintain a sustained and coordinated focus on OA

Regarding Strategy 3: Increase ability to adapt and remediate the impacts of OA