

pH sensors

Todd Martz

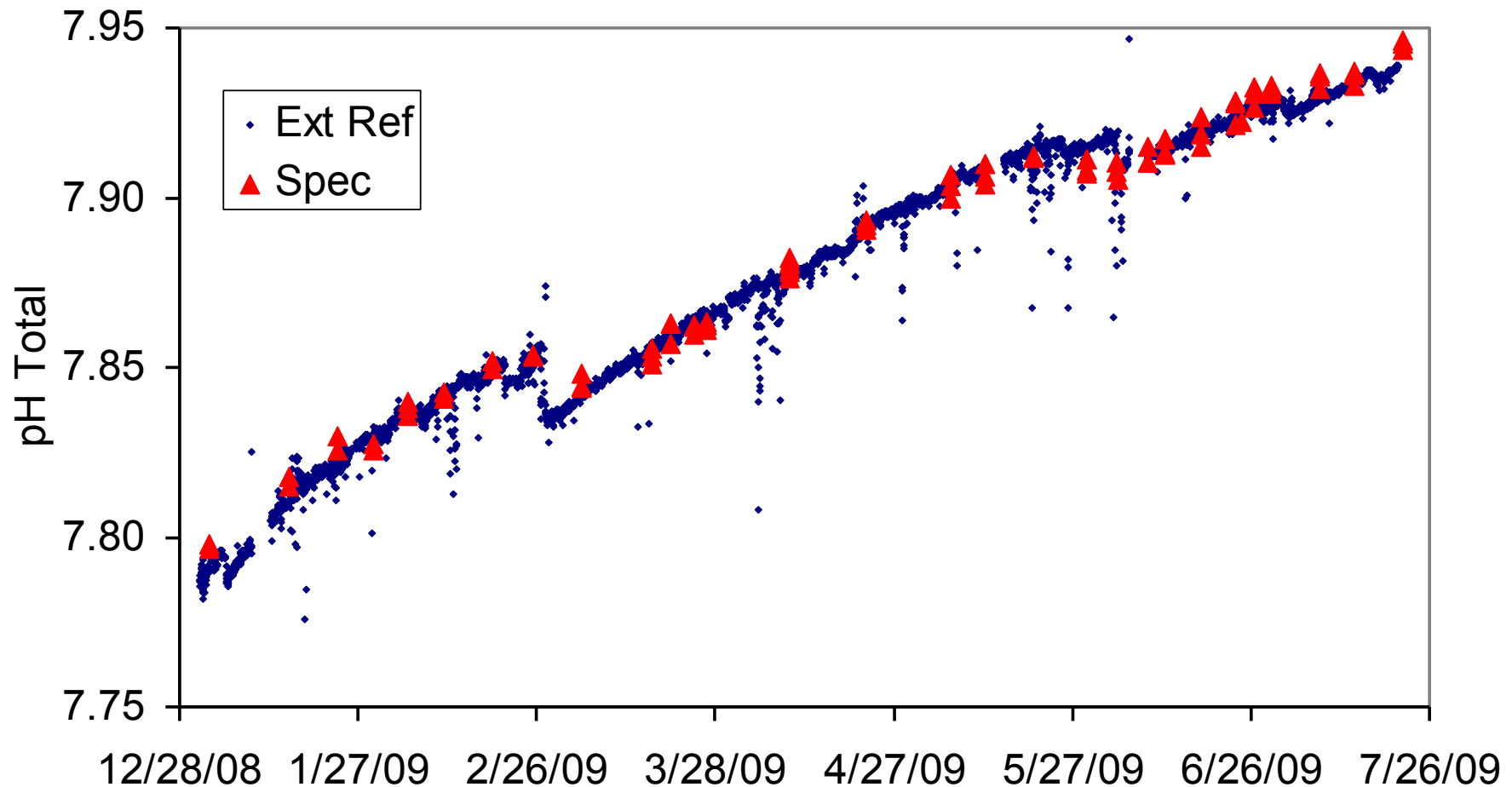
Scripps Institution of Oceanography

C-CAN workshop 6-7 July 2011

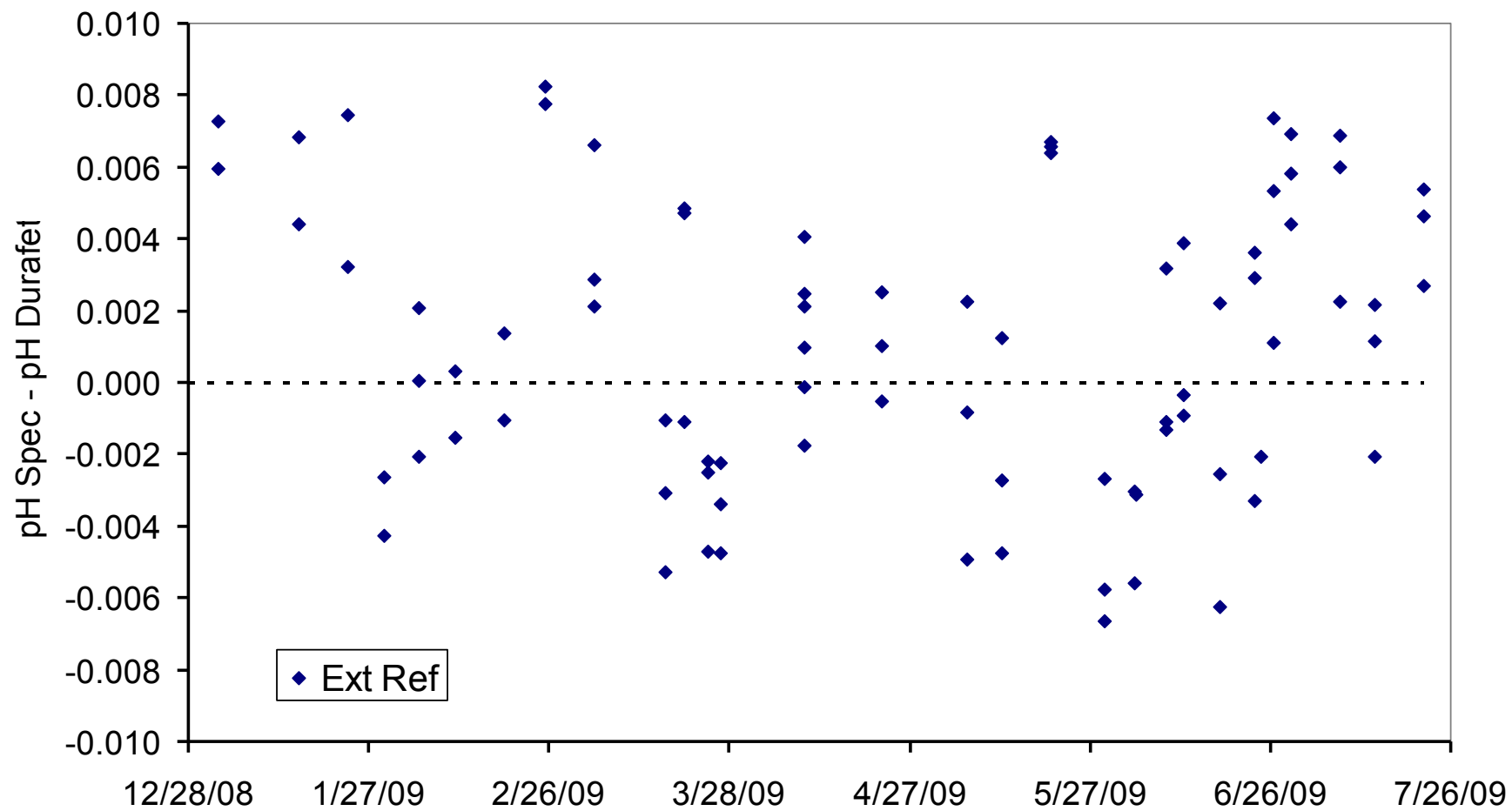
Autonomous Sensors



8 months Durafet pH data in MBARI test tank compared to periodic spectrophotometric pH measurements of tank water. pH is changing because tank was re-equilibrating with atmosphere after filling. Occasional tank pH shifts are due to testing of liquid CO₂ experiments by P. Brewer.

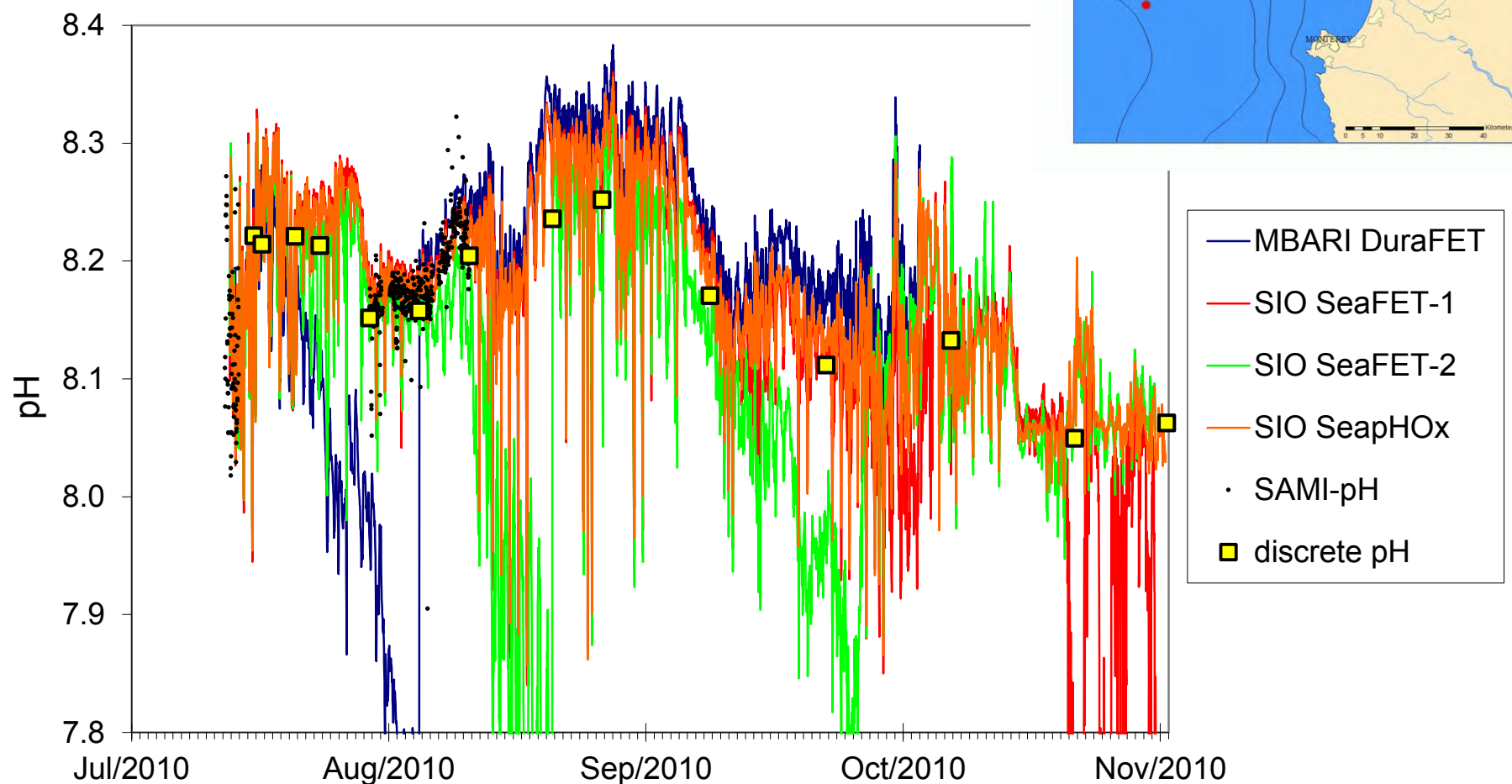


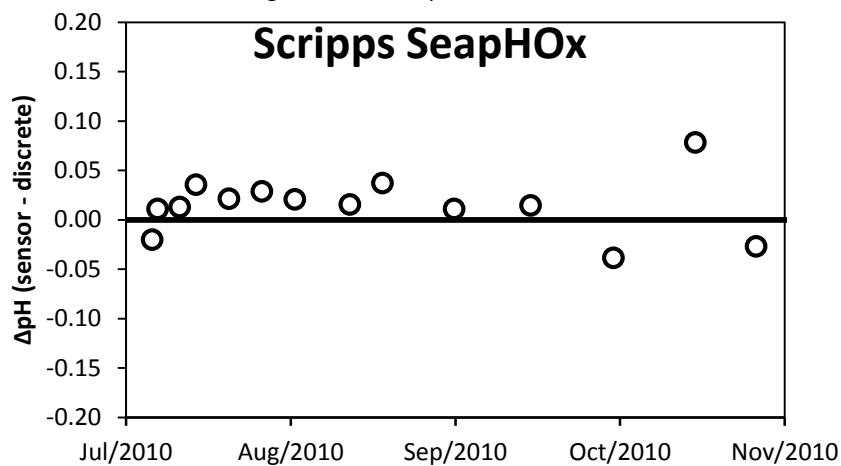
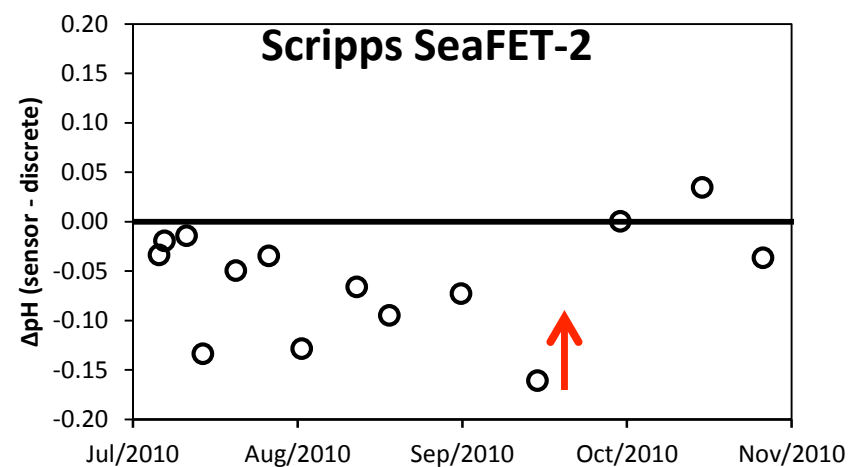
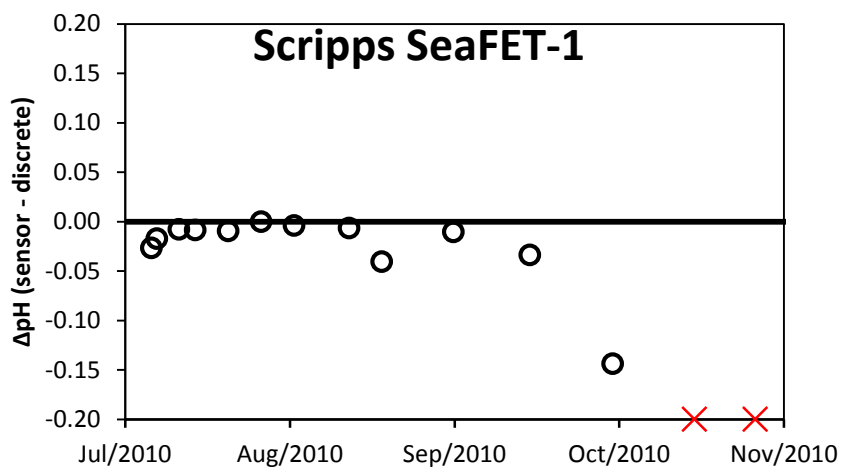
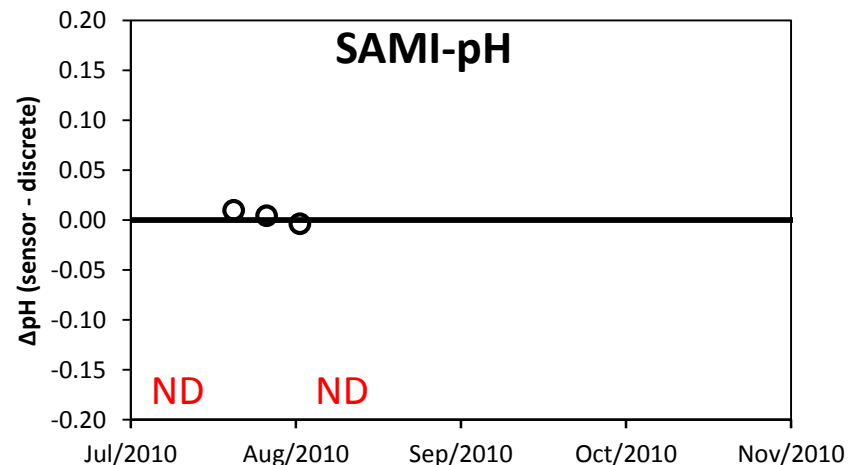
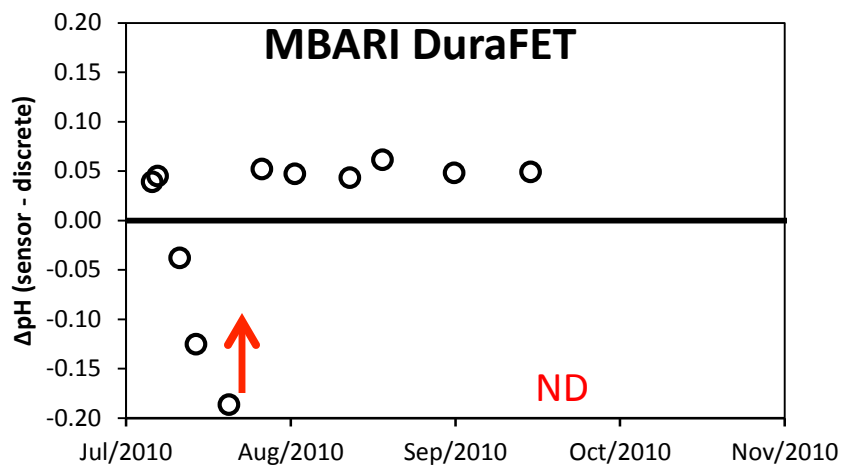
Difference from spec measurements average ± 0.005 pH over months.



pH Sensor Intercomparison

Carried out in Monterey Bay in 2010 by Ken Johnson's group at MBARI, using LOBO mooring L20.





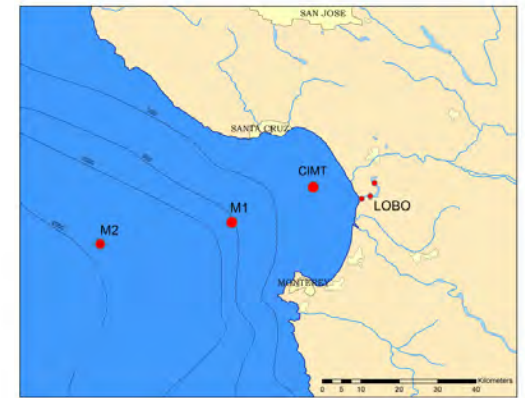
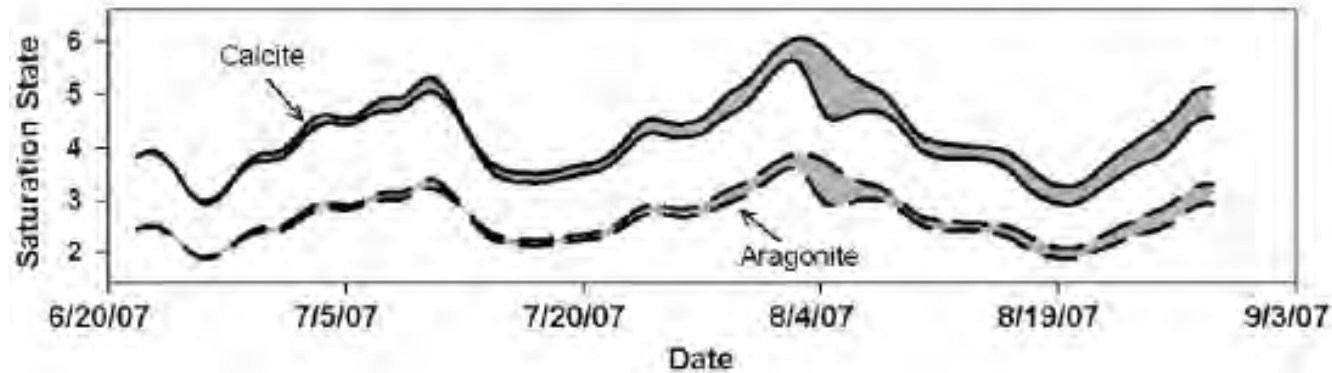
ND = No data / sensor failure

x = error off scale

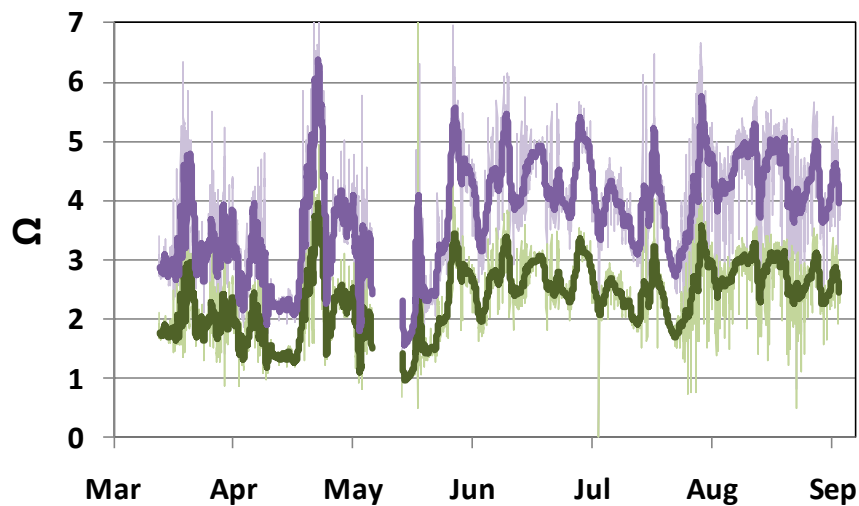
↑ = sensor cleaned

Saturation State

S.E. Cullison Gray et al. / Marine Chemistry 125 (2011) 82-90



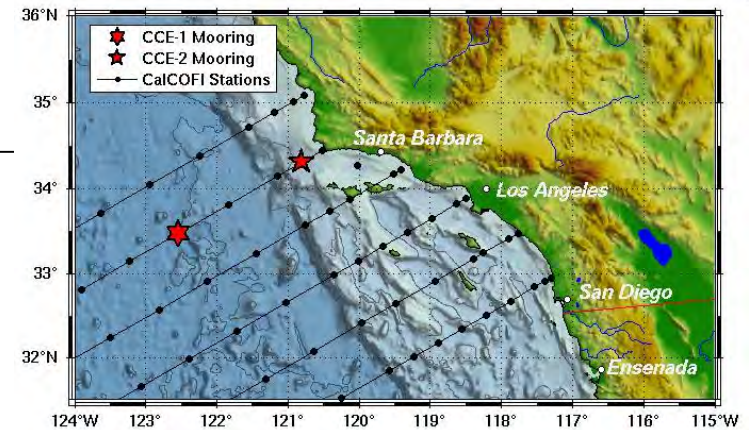
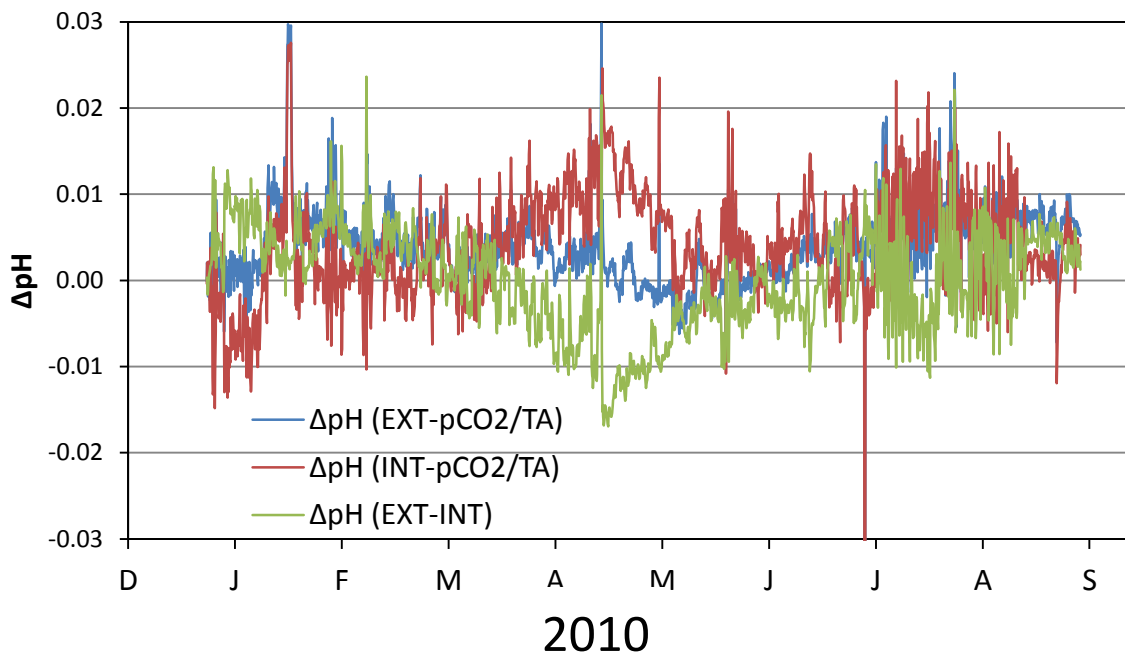
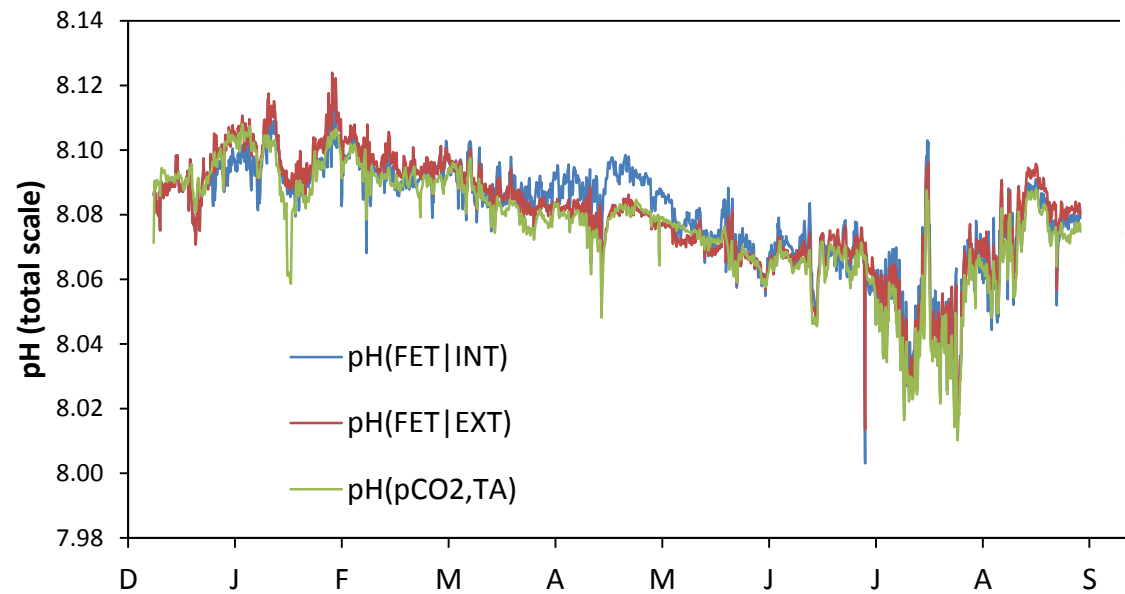
Autonomous measurements of pH and partial pressure of CO₂ now make it possible to continuously observe saturation state to ~0.1



Saturation state of Calcite

Saturation state of Aragonite

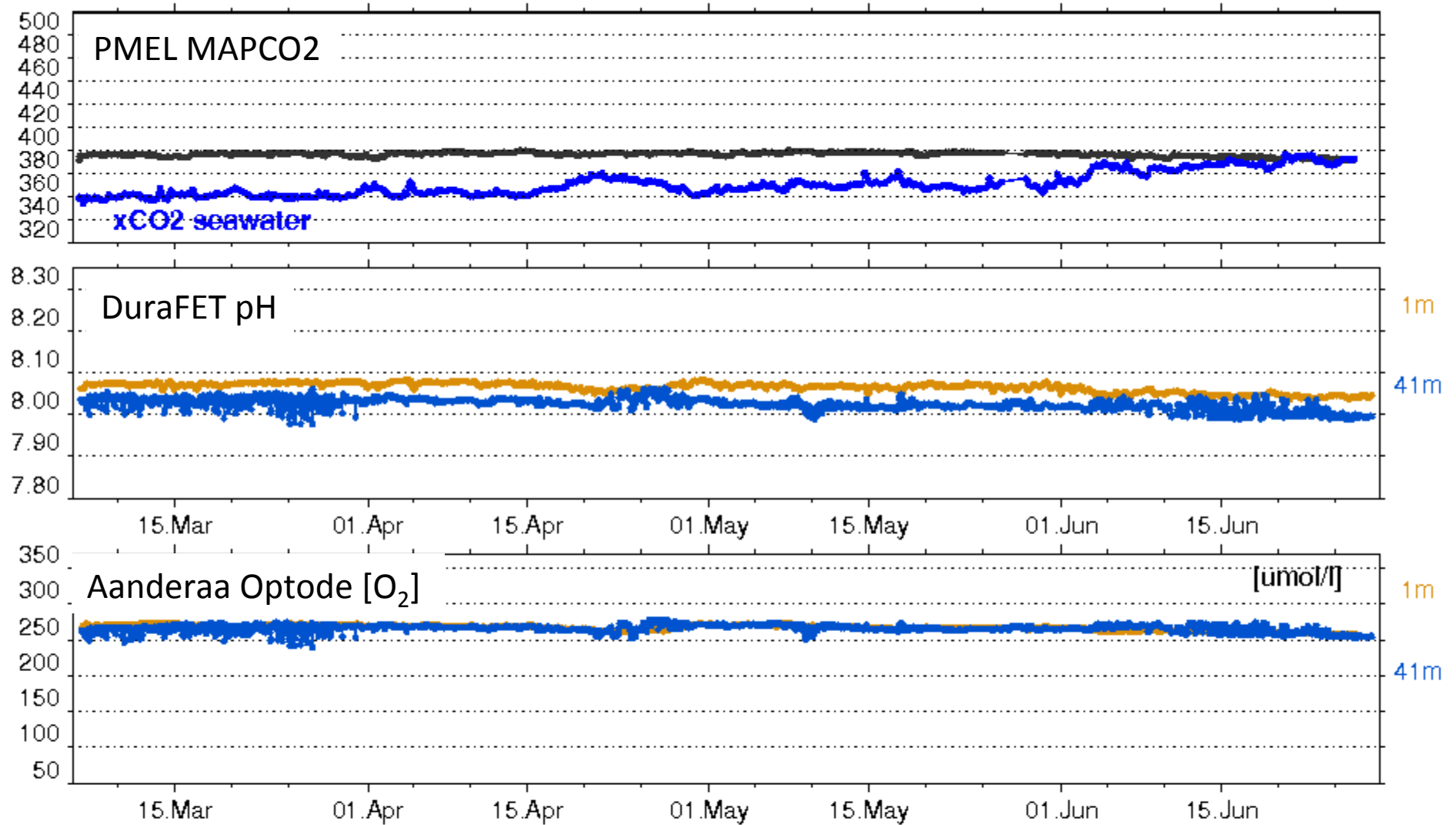
Sensor Performance



pH measured using a modified Honeywell Durafet and estimated from pCO₂ using TA = f(S,T) provided by Simone Alin.

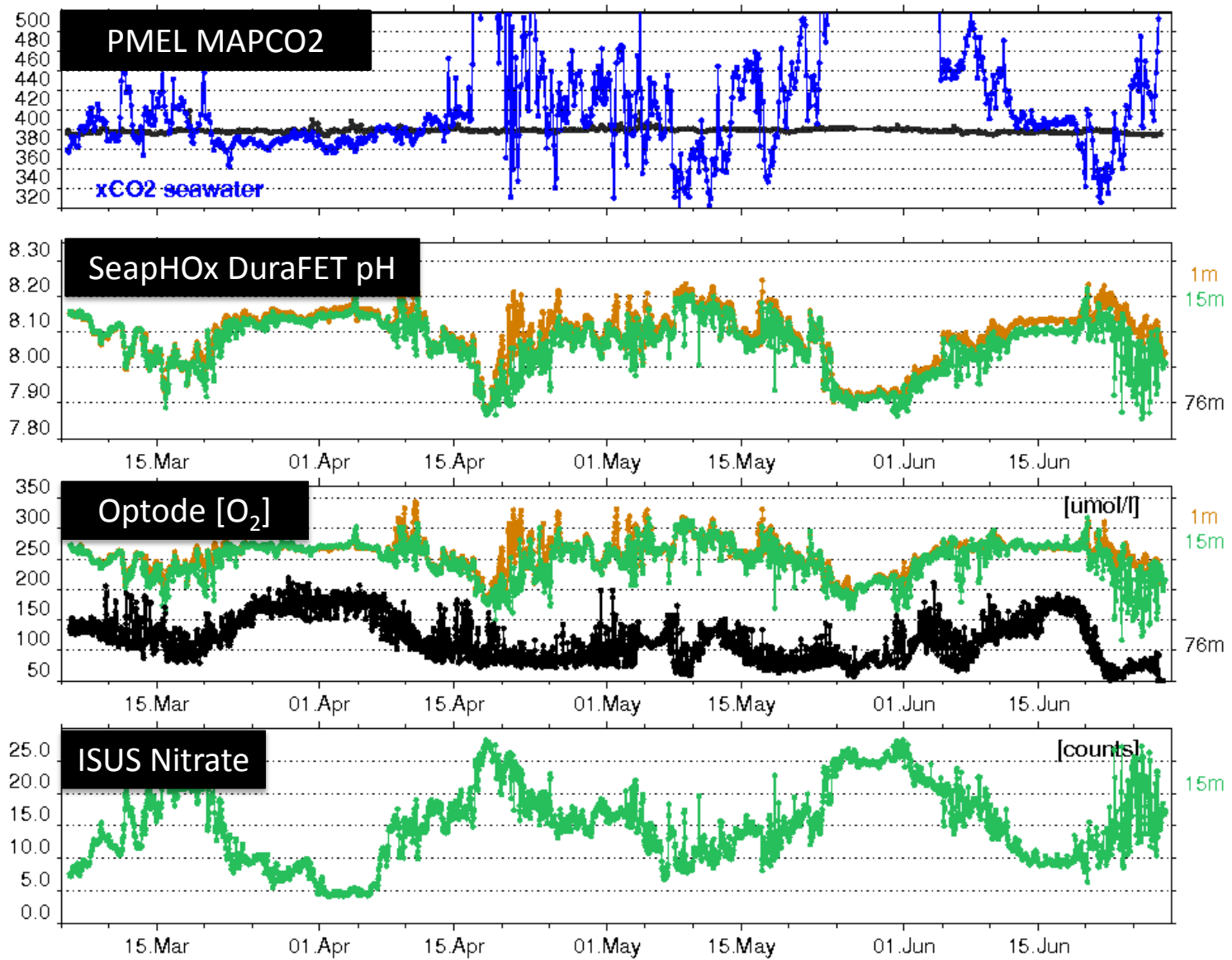
Examining the agreement between the three different pH values provides a useful QC on sensor data.

CCE1 Present Deployment <http://mooring.ucsd.edu/>



2011

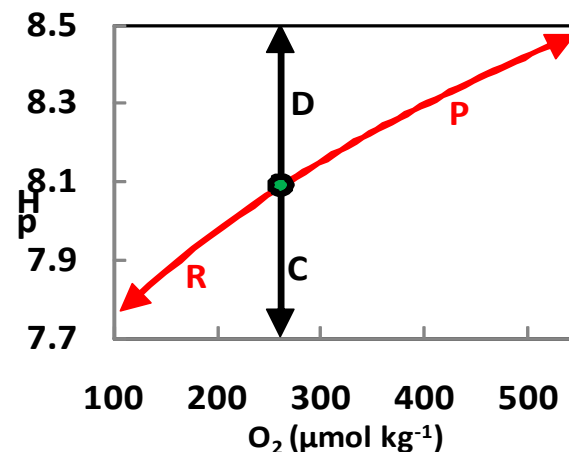
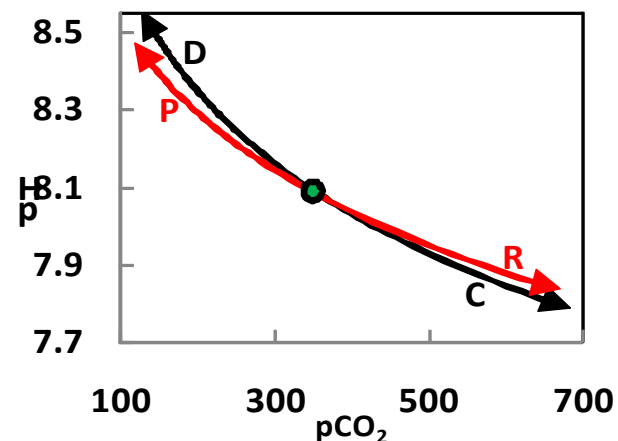
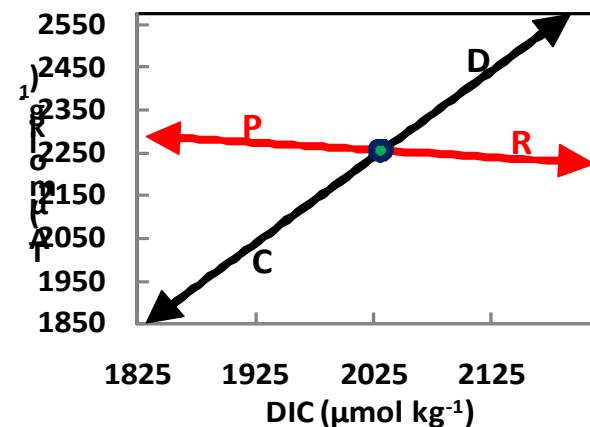
CCE2 Present Deployment <http://mooring.ucsd.edu/>



2011

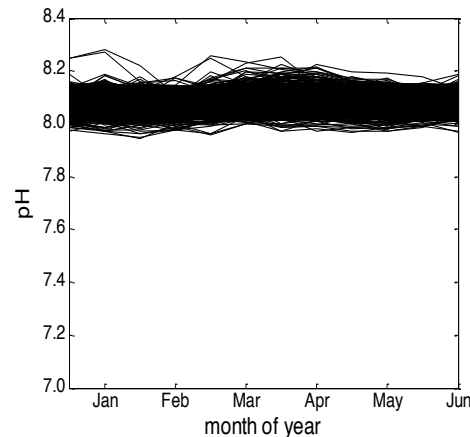
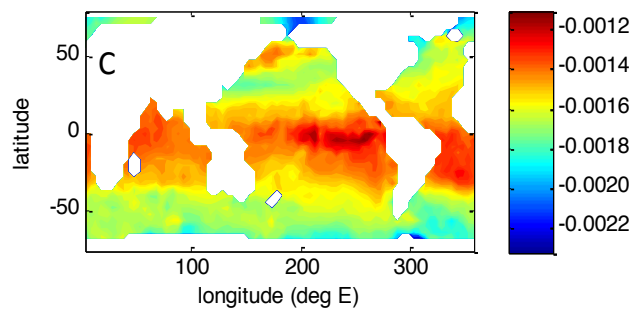
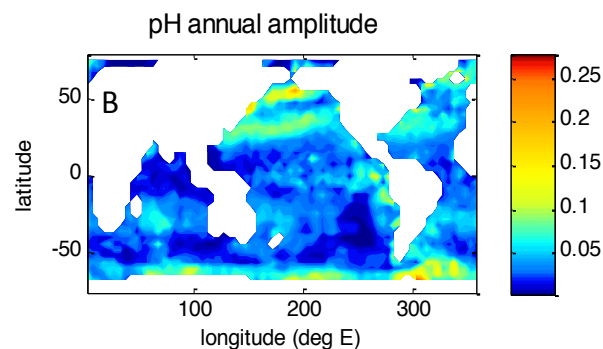
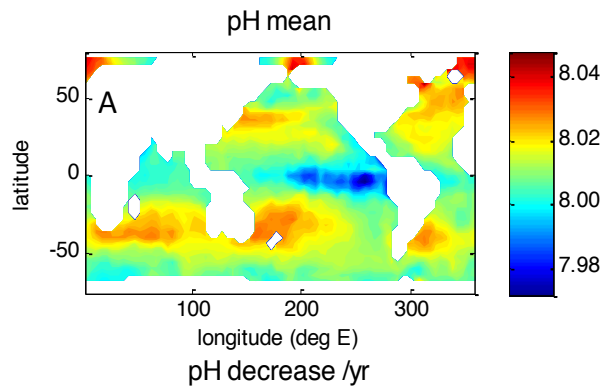
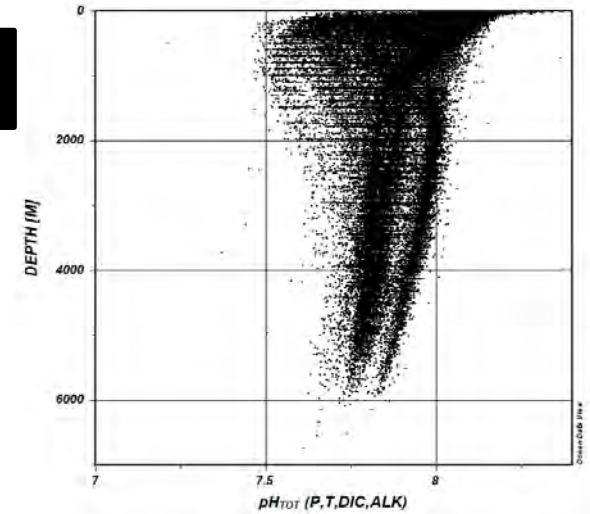
Why should we co-locate pH & O₂ sensors?

- Useful combination for separating biogeochemical rates (CaCO₃ vs. C_{org}).
- Even when pH and O₂ are expected to be tightly correlated, sensor redundancy serves as an important verification tool.
- pH-O₂ correlation relationship can change with water mass, depth, time of day.



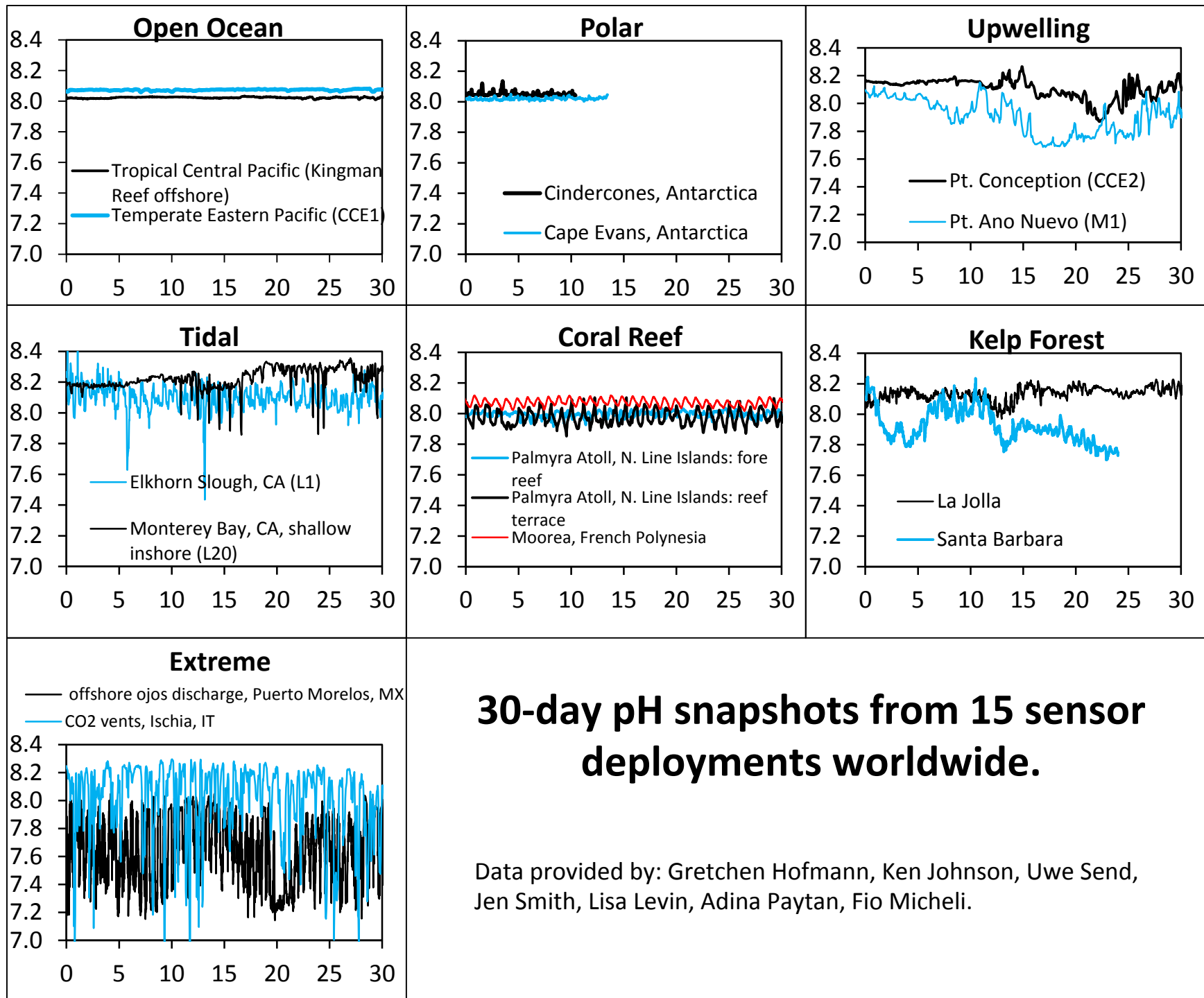
Putting Ocean Acidification in Context

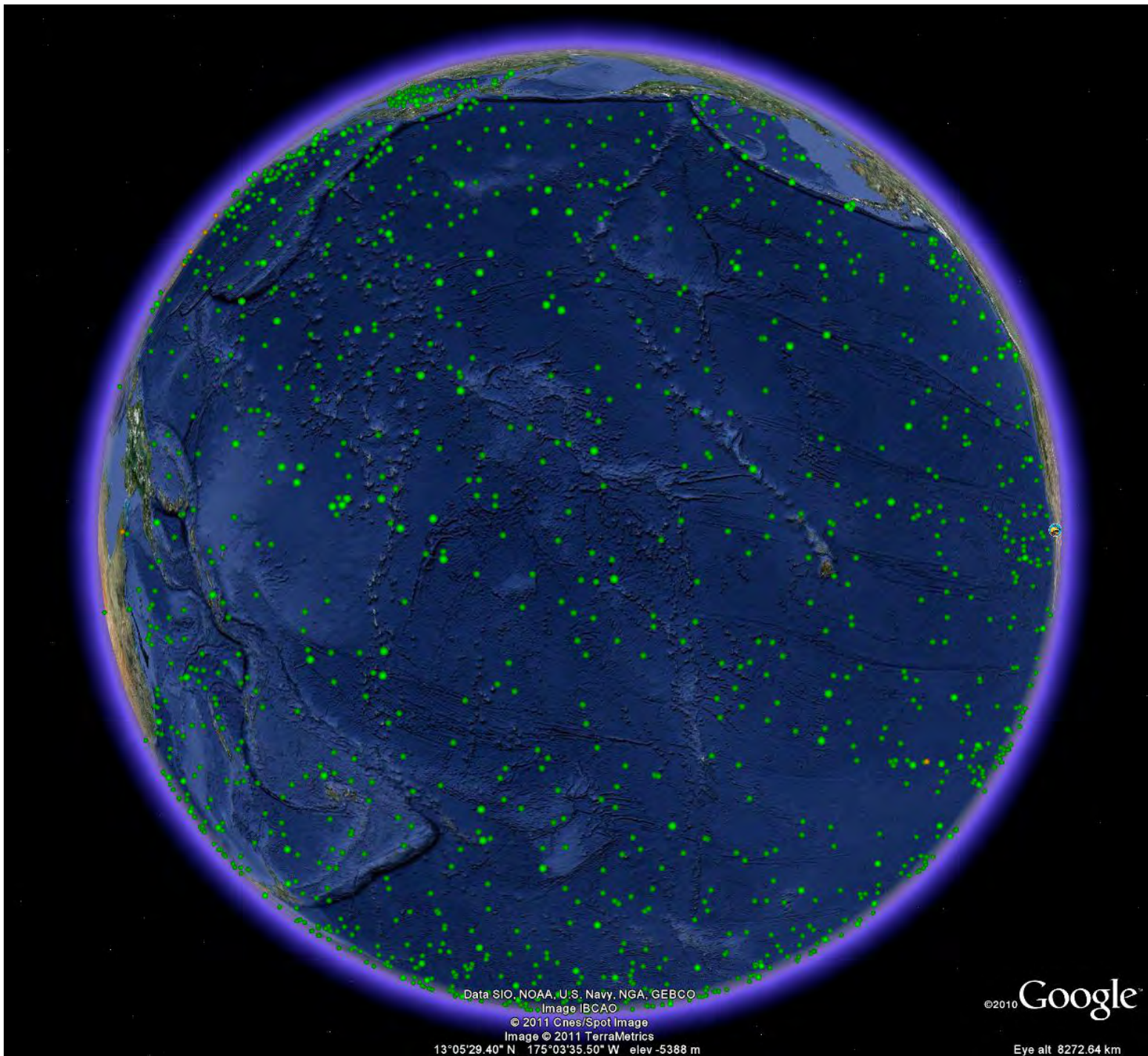
- Historical data provide a good starting point, but do not tell the entire story, especially in the coastal ocean.
- Sensors are the only way to characterize regions of high variability.



↑
All WOCE data

← CO₂ climatology for the Open Ocean



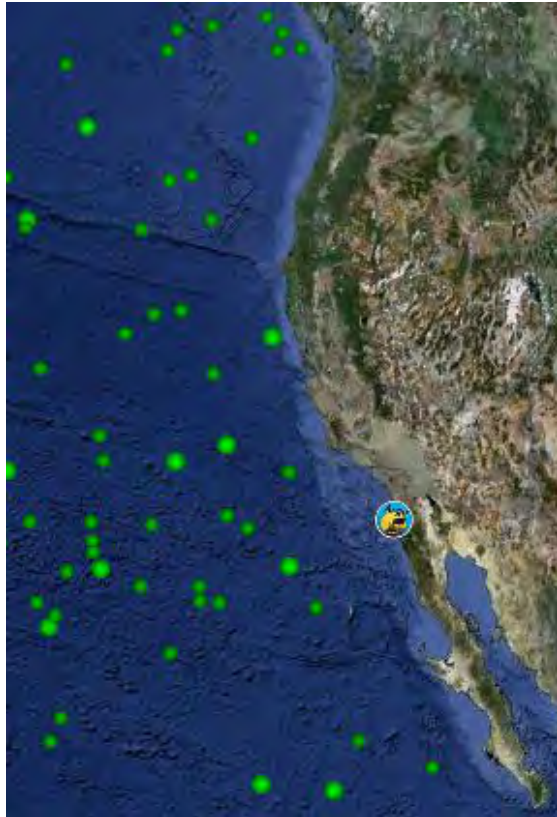


Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
© 2011 Cnes/Spot Image
Image © 2011 TerraMetrics
13°05'29.40" N 175°03'35.50" W elev -5388 m

©2010 Google

Eye alt 8272.64 km

~50 Argo floats off west coast.



Trajectories for 4 floats with lifetimes > 3 years. Floats stay in California Current.

