

Keeping an eye on ocean acidification in the shellfish hatchery

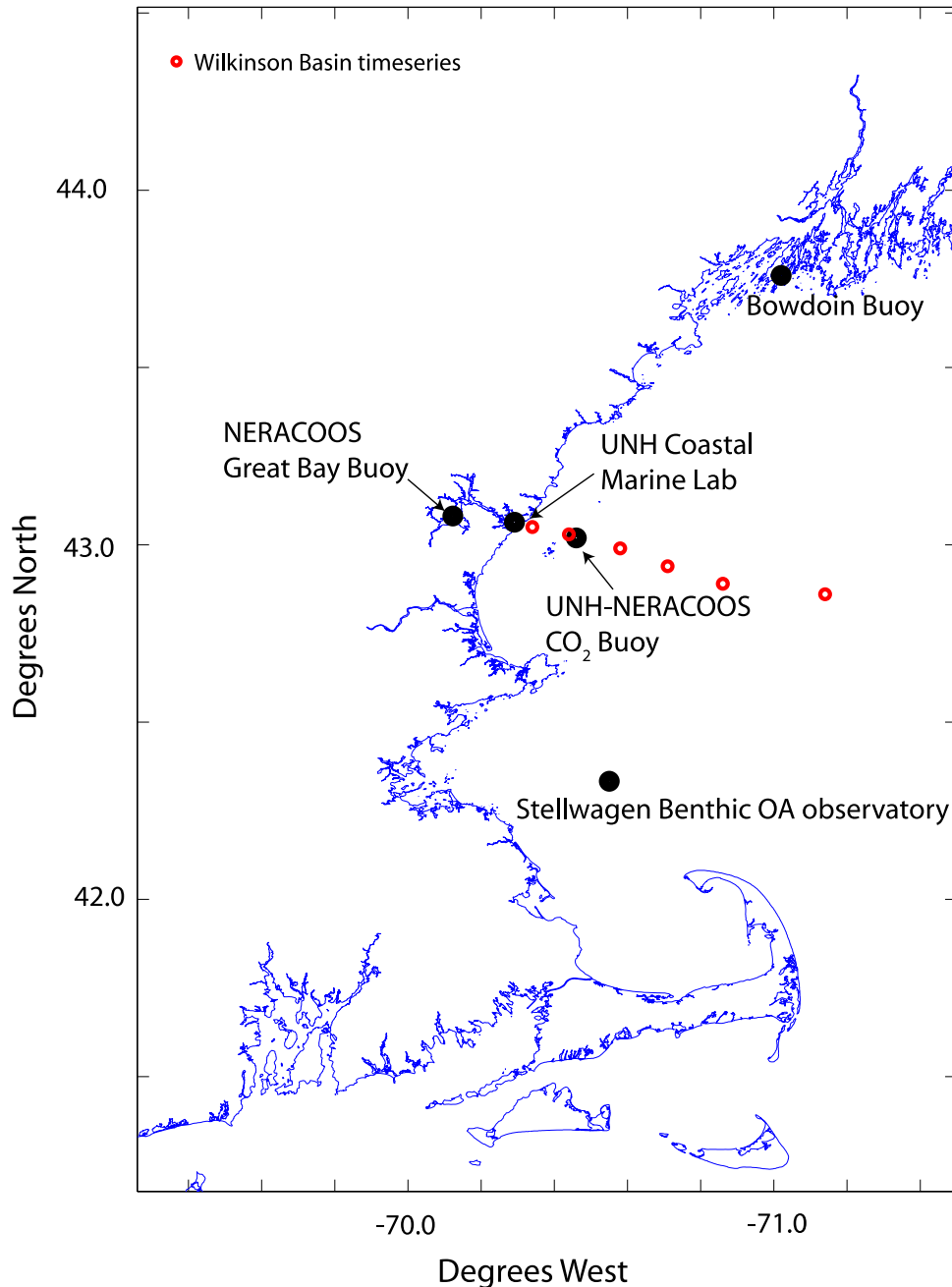
Issue addressed: Optimization of growth cycles for shellfish aquaculture.

Prior limitations: Operators are often blind to sub-optimal growth conditions caused by OA

**Threshold for suitable larval growth in clams
and oysters:**

>1.6 (Barton et al., 2011, Salisbury et al., 2008)

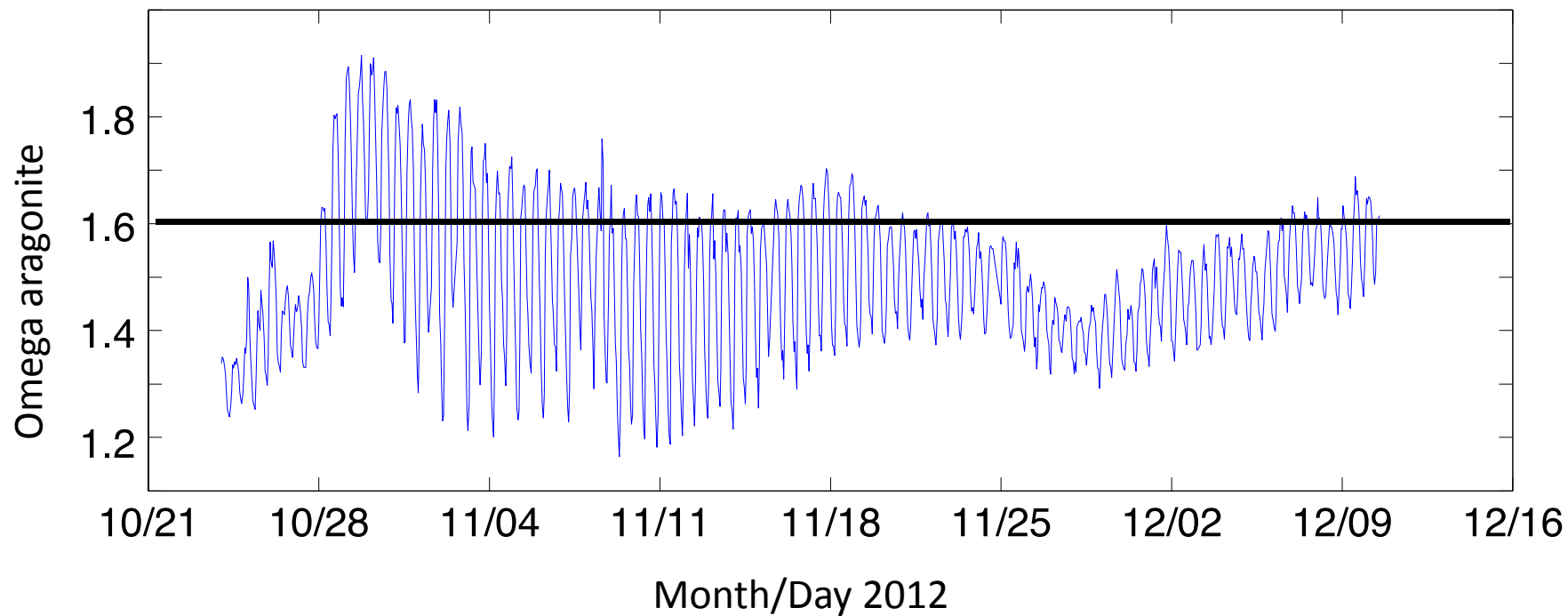
Coastal Gulf of Maine OA time series



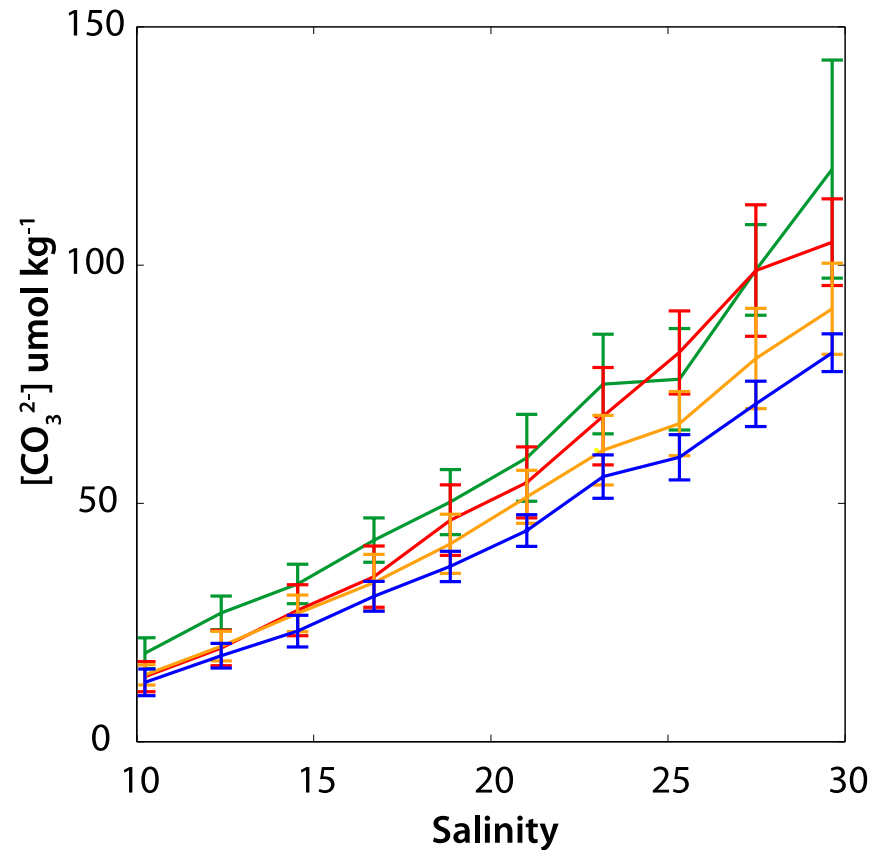
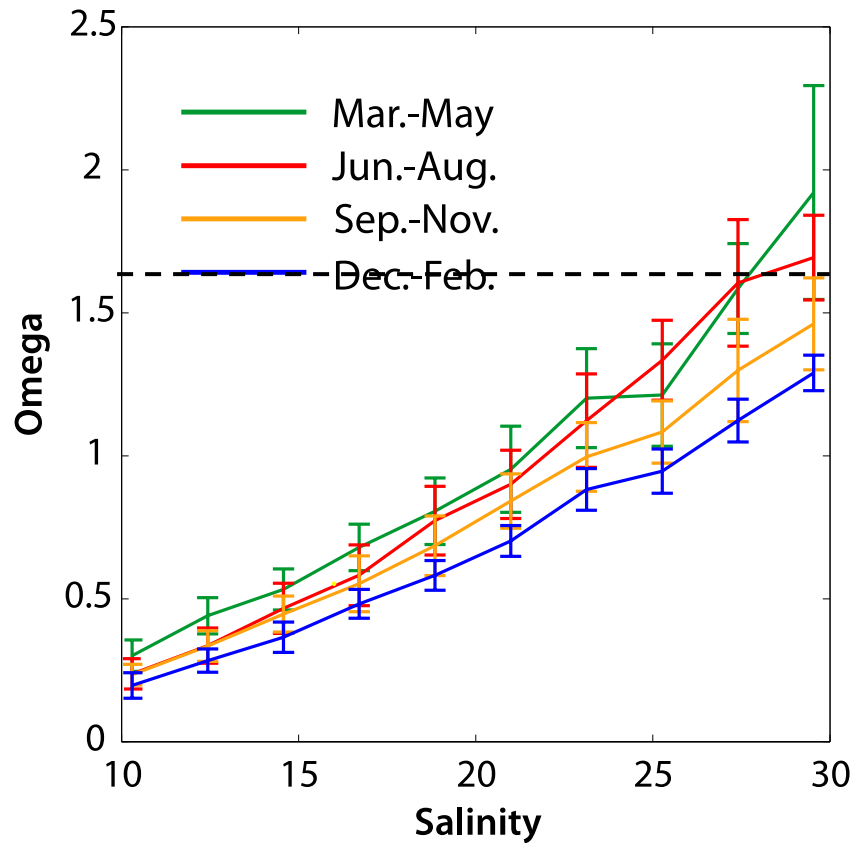
Given a suitable index of 1.6, is OA a plausible threat to the coastal shellfishery?

Consider local NERACOOS observations....

Omega aragonite at the UNH Coastal Marine Lab

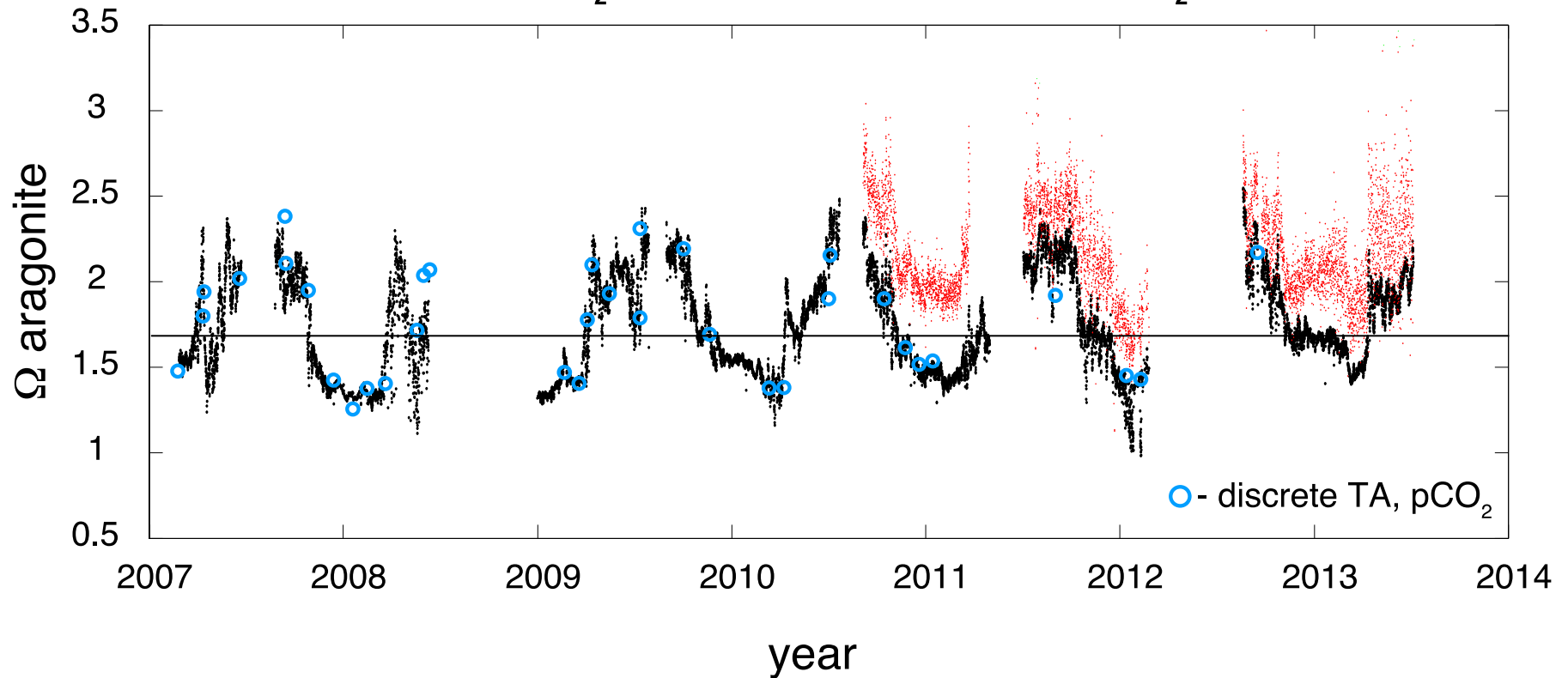


Omega (Ω) (left panel) in the Kennebec Plume (56 cruises)



UNH – NERACOOS CO₂ Buoy

Omega aragonite (pCO₂ and salinity-TA, black), (pCO₂ and pH, red)



Different technologies and price points

Level 1 – \$10k

- Measure pH, salinity and temperature continuously
- Model Ω

Level 2 – \$20k

- Add continuous pCO_2 measurements
- Estimate Ω more directly

Level 3 – >\$60k

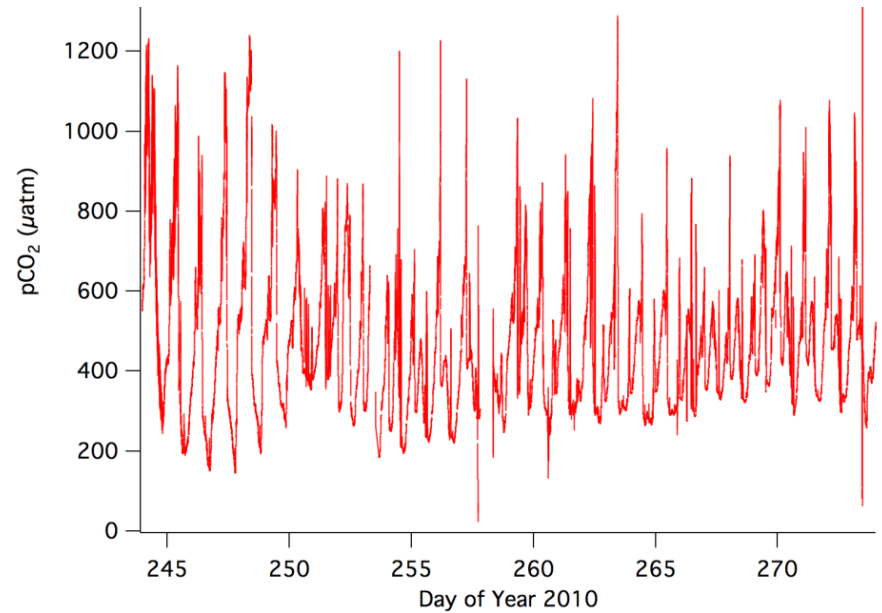
- Continuous, real time estimates of Ω from an over-determined system (pCO_2 , pH and either Total Alkalinity or TCO_2)

New Technology

Continuous pCO₂ data – the ‘Burkilator’ (~\$25k)

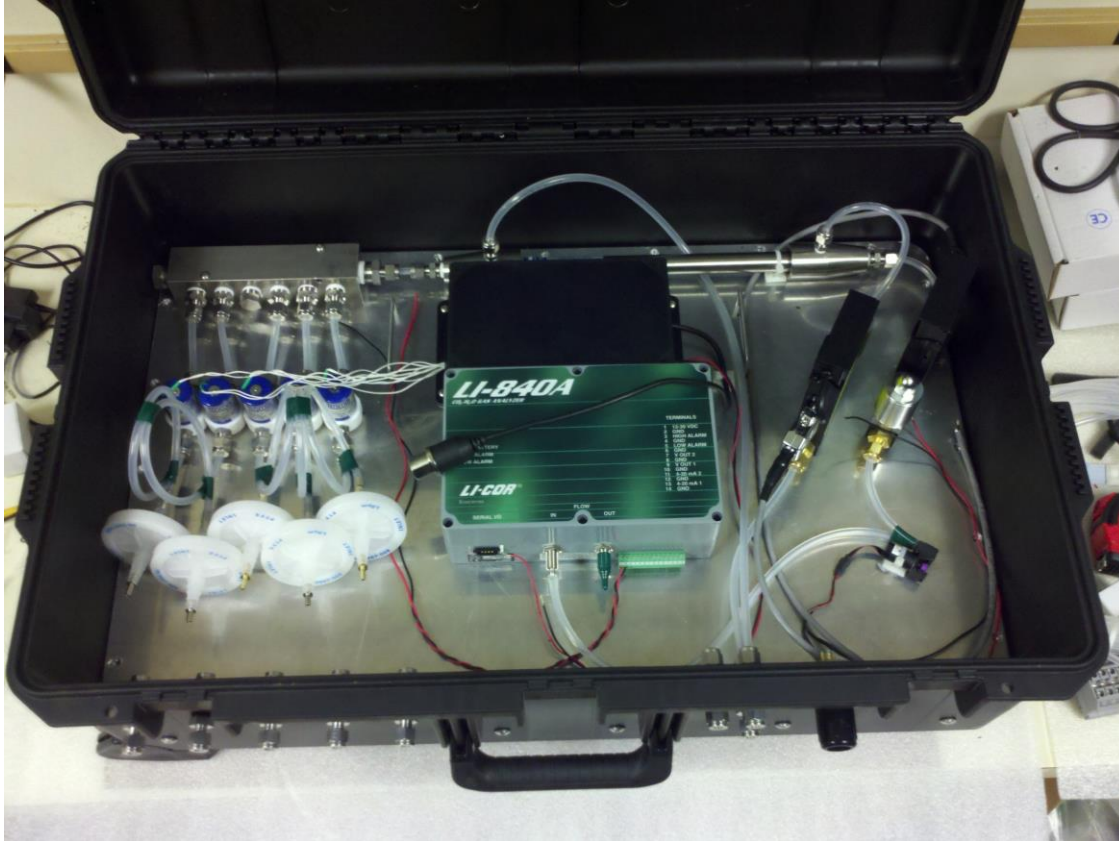
Burke Hales, Jesse Vance – OSU COAS

- Provides real-time pCO₂ measurements of incoming seawater
- Not an off-the-shelf instrument, and requires some technical support
- Sunburst Sensors sells both wall-mounted and deployable systems



New Technology

Continuous pCO₂ data –the UNH Bubbalator (<\$20k)



Deployed continuously at the UNH Coastal Marine Lab since 2011
First Hatchery deployment (Bevan's Oyster) March, 2014

On the subject of less expensive: CO₂meter.com pCO₂ sensor



SE-0117

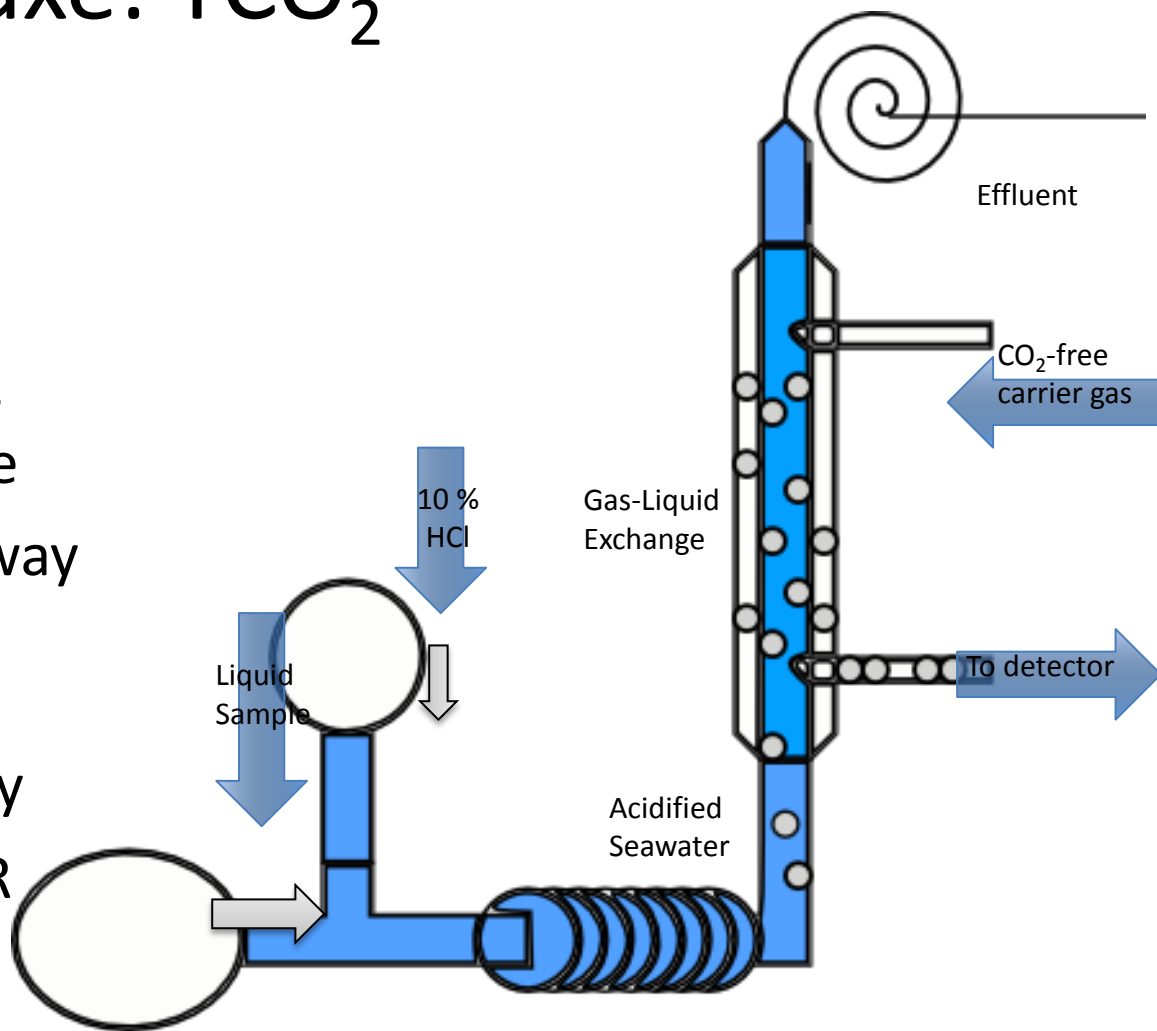
- These units are \$219 and could substantially lower the cost of pCO₂ measurements.

- UNH testing suggest that +/- 0.2 Ω is achievable with this unit

New Technology

Burkilator Deluxe: TCO₂

- Low-flow Seawater sample is acidified
- Dissolved through a microporous, hydrophobic membrane
- Evolved CO₂ is swept away by a high-flow CO₂-free carrier gas with nearly 100% removal efficiency
- CO₂ is detected by NDIR



HydroC™ CO2 Carbon Dioxide Sensor below, extensively tested at the UNH Coastal Marine Lab



- A new, robust Total Alkalinity sensor is under development
- Targeted for the market in 2014

Last slide:

- Need another carbonate parameter ($p\text{CO}_2$, TA or TCO_2)
- Need to get within $\pm 0.2 \Omega$ at a much lower cost
- Need to keep the technical support demands manageable
- Burke Hales and Jesse Vance (OSU), Alan Barton (Whisky Creek Hatchery)

