Developing a Profiling Glider pH Sensor for High Resolution Coastal Ocean Acidification Monitoring

Grace Saba, Elizabeth Wright-Fairbanks, Travis Miles

Baoshan Chen, Wei-Jun Cai, Kui Wang

Andrew Barnard, Charles Branham

Clayton Jones

RUTGERS THE STATE UNIVERSITY OF NEW JERSEY

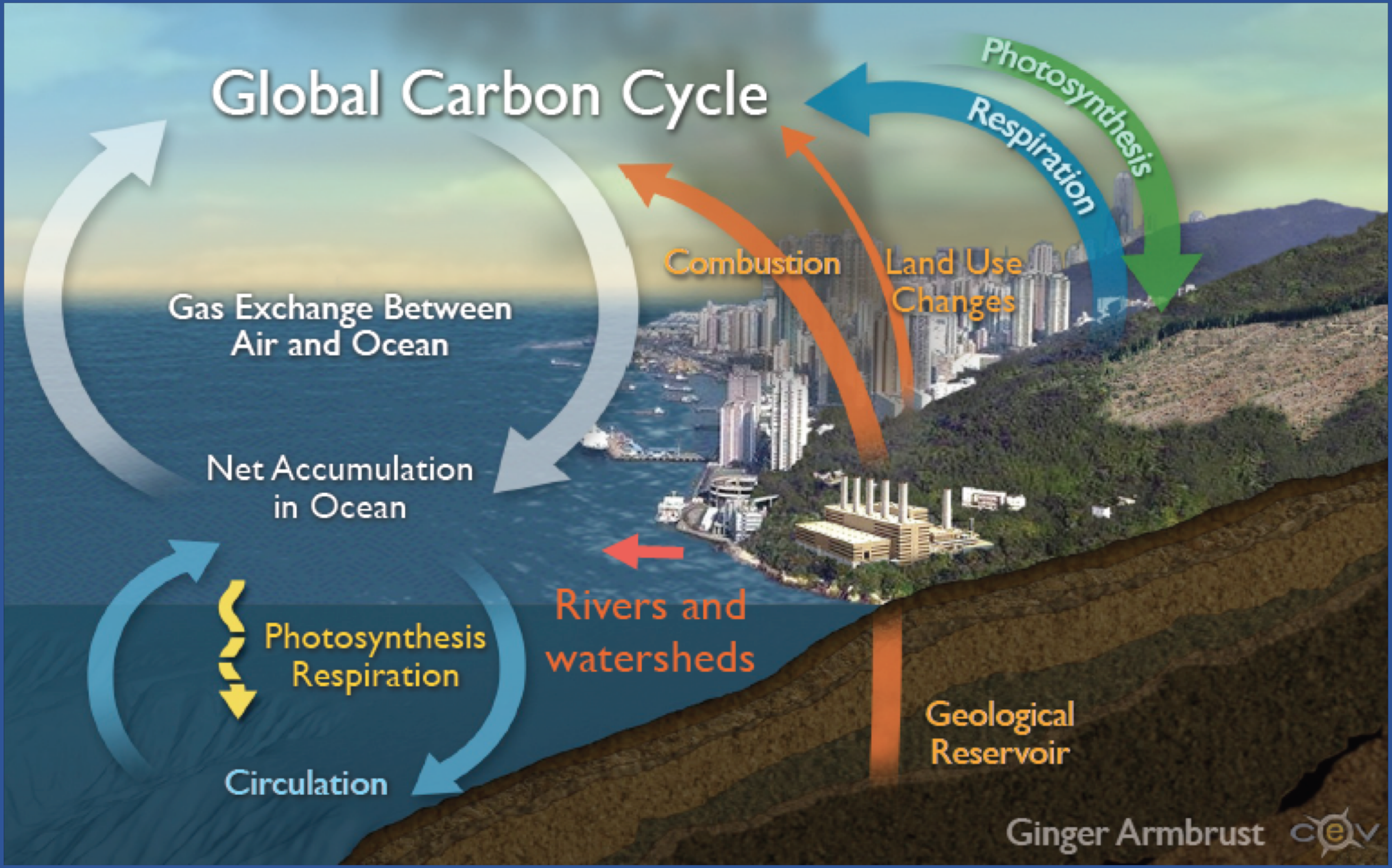
SEA·BIRD SCIENTIFIC

UNIVERSITY OF DELAWARE

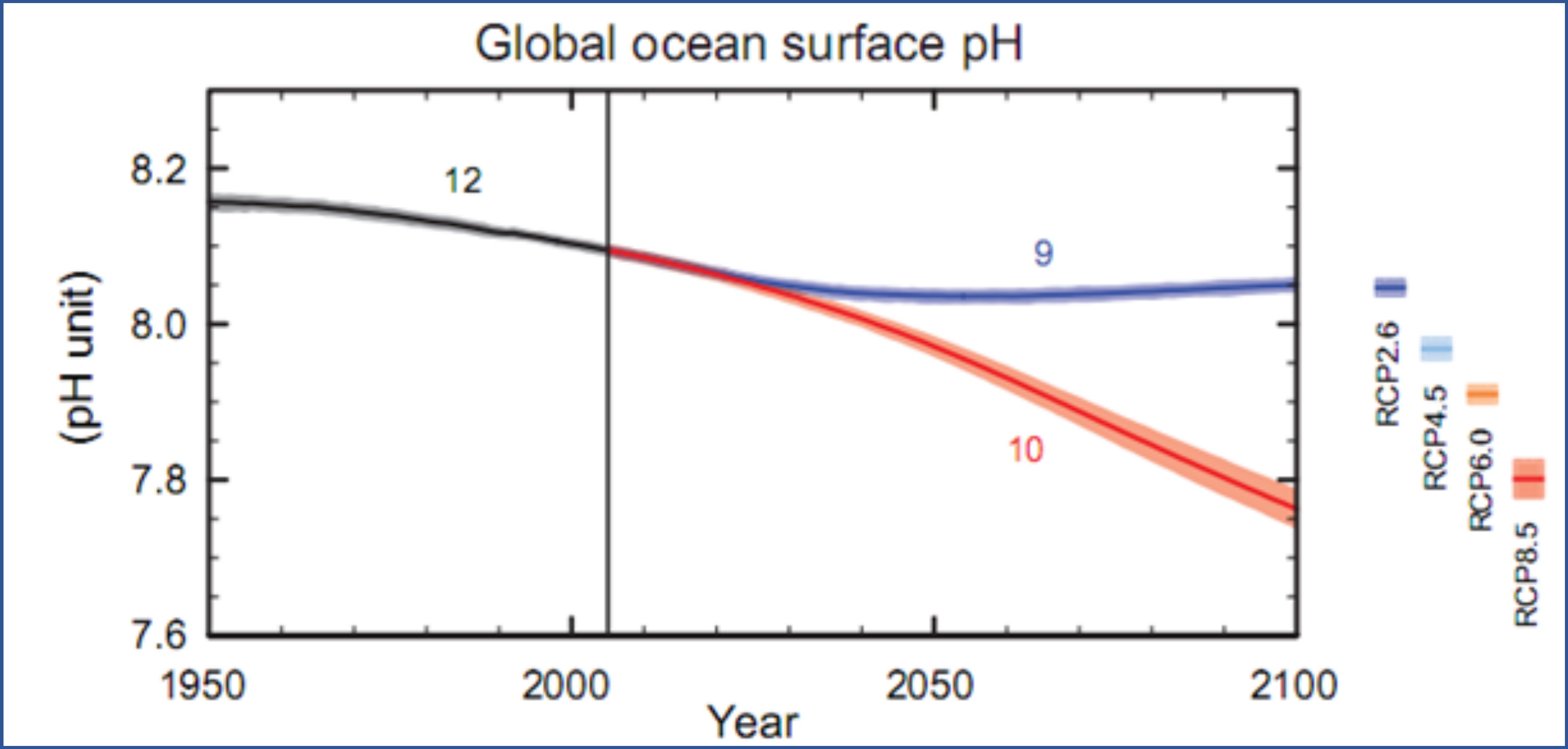
TELEDYNE MARINE Everywhereyoulook™

Ocean Acidification

Driven by the ocean's absorption of increasing atmospheric carbon dioxide (CO_2)

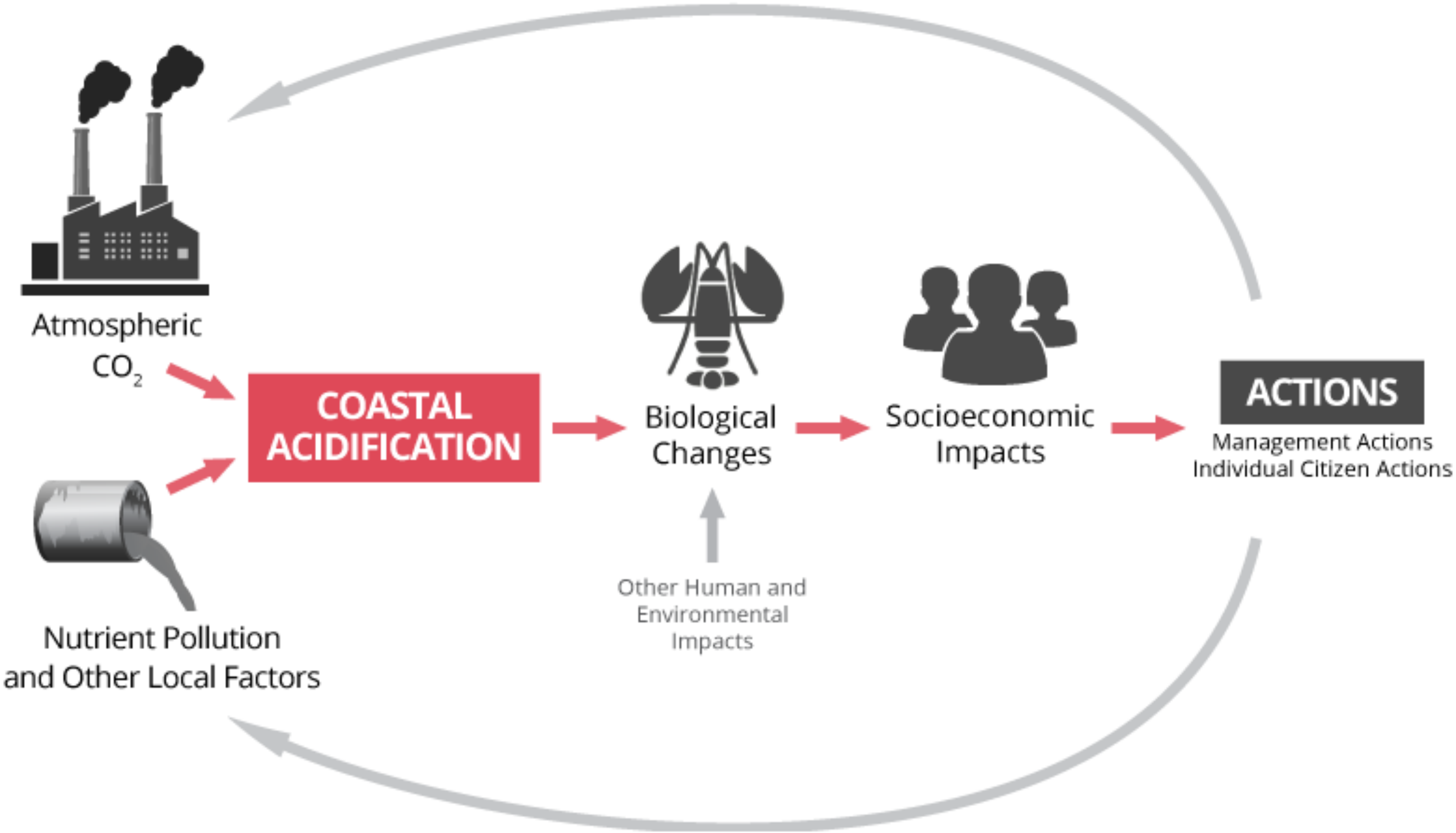


Ocean Acidification - Projections



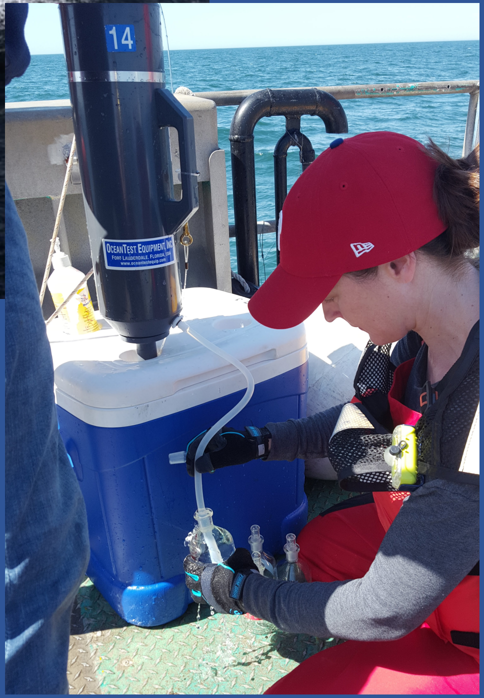
2013 IPCC Fifth Assessment Report (AR5)

Links Between People and Coastal Acidification

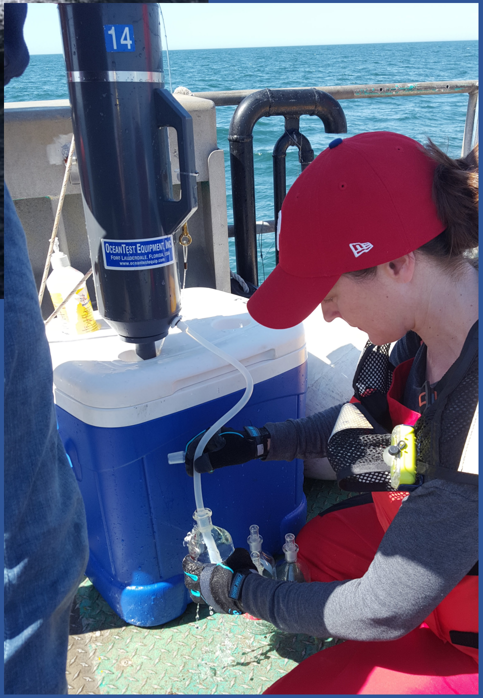


IOOS

Traditional pH Monitoring Platforms



Traditional pH Monitoring Platforms



Most gaps can be addressed through advancements in pH sensor technology

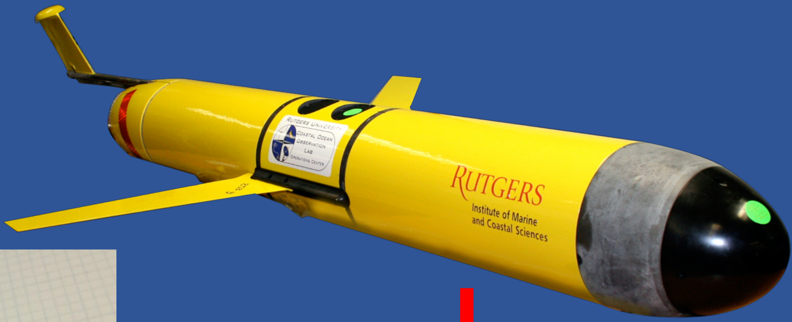
Improvements in Design and Application

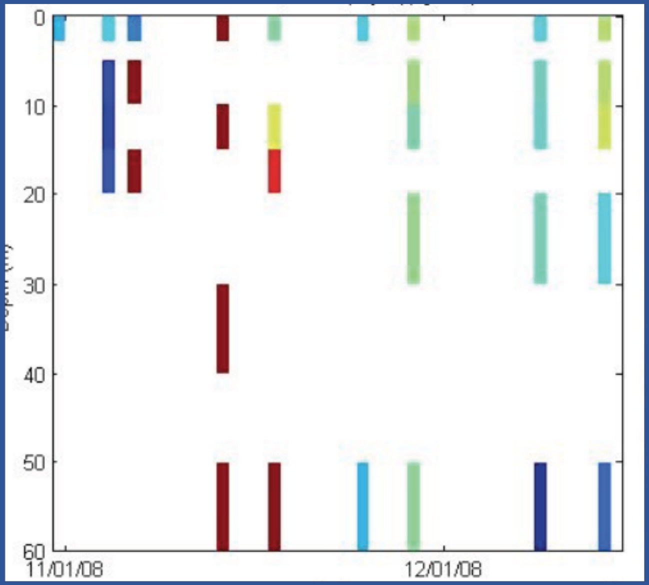
Depth-profiling deep-sea ISFET pH

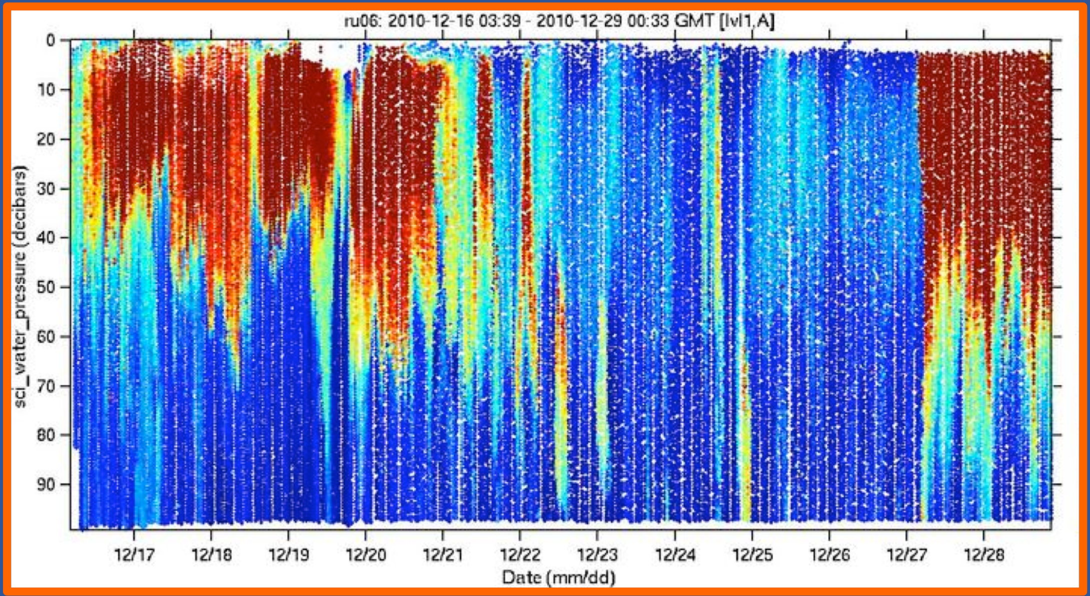
<u>Academic and Industry collaboration</u>:
Ken Johnson, MBARI
Todd Martz, Scripps
Honeywell
Sea-Bird Scientific

*Finalists in the Wendy Schmidt Ocean Health XPRIZE

Advantages of Glider-based pH Monitoring





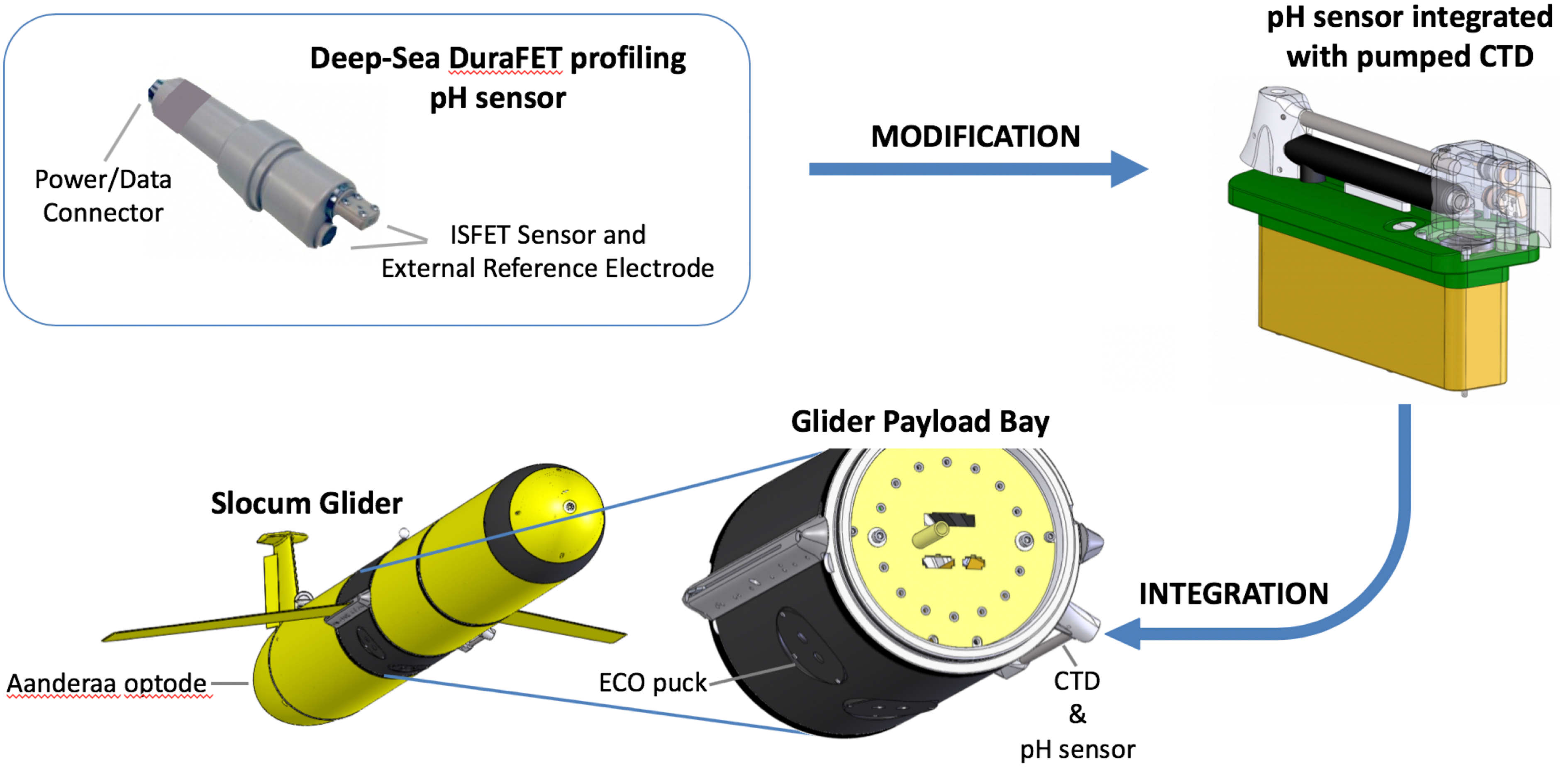


Project Goals and Applications

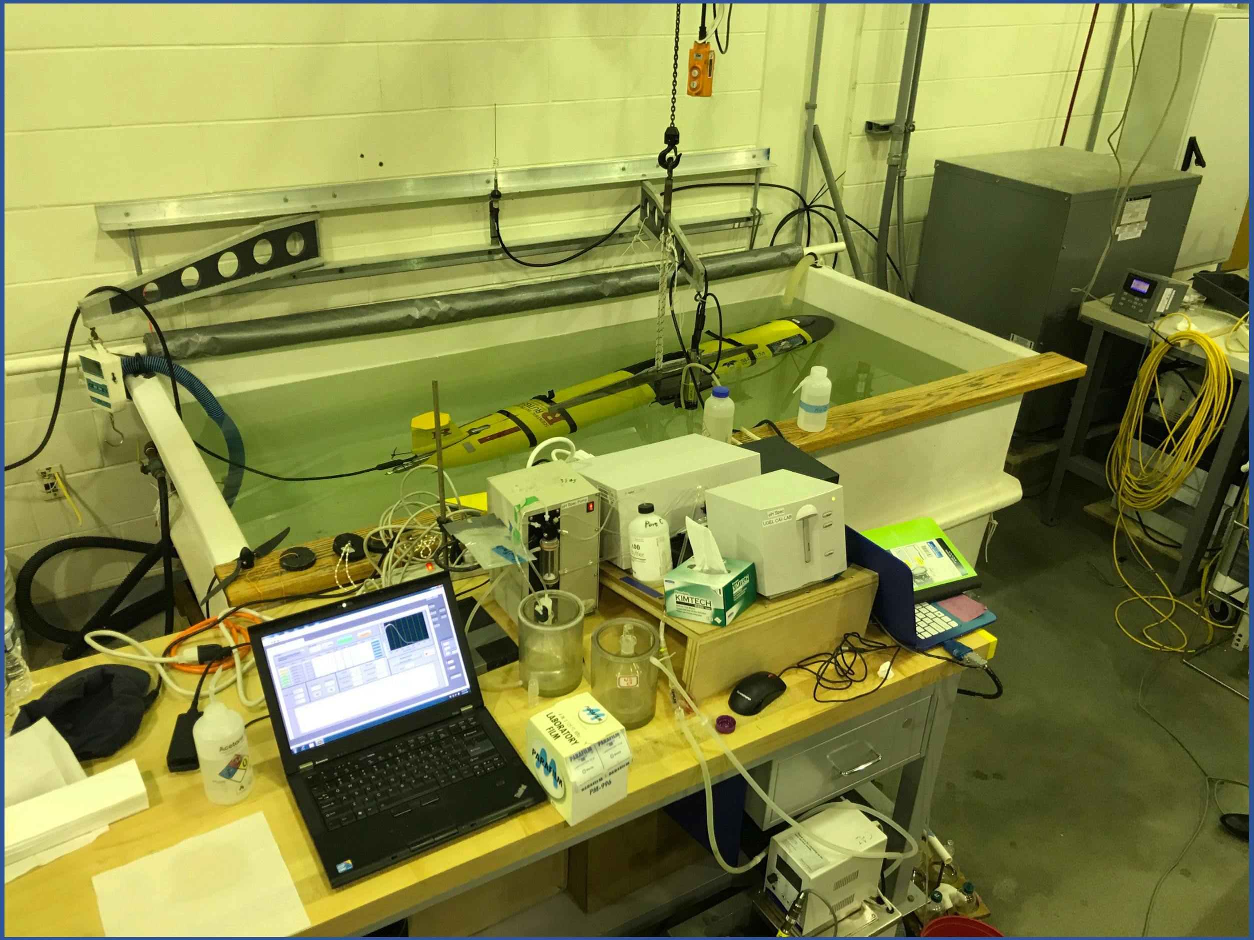
- Develop and integrate a Deep-Sea ISFET profiling pH sensor into a glider and conduct laboratory testing and calibration
- Conduct glider deployments to demonstrate high resolution measurements of pH in coastal regions in near real-time
- Determine natural variability that will provide a framework to better study organism response and design more realistic experiments
- Identify and monitor high-risk areas that are more prone to periods of reduced pH and/or high pH variability

  ➢ Enable better modeling and management of essential habitats in future, more acidic oceans

Sensor Development and Integration

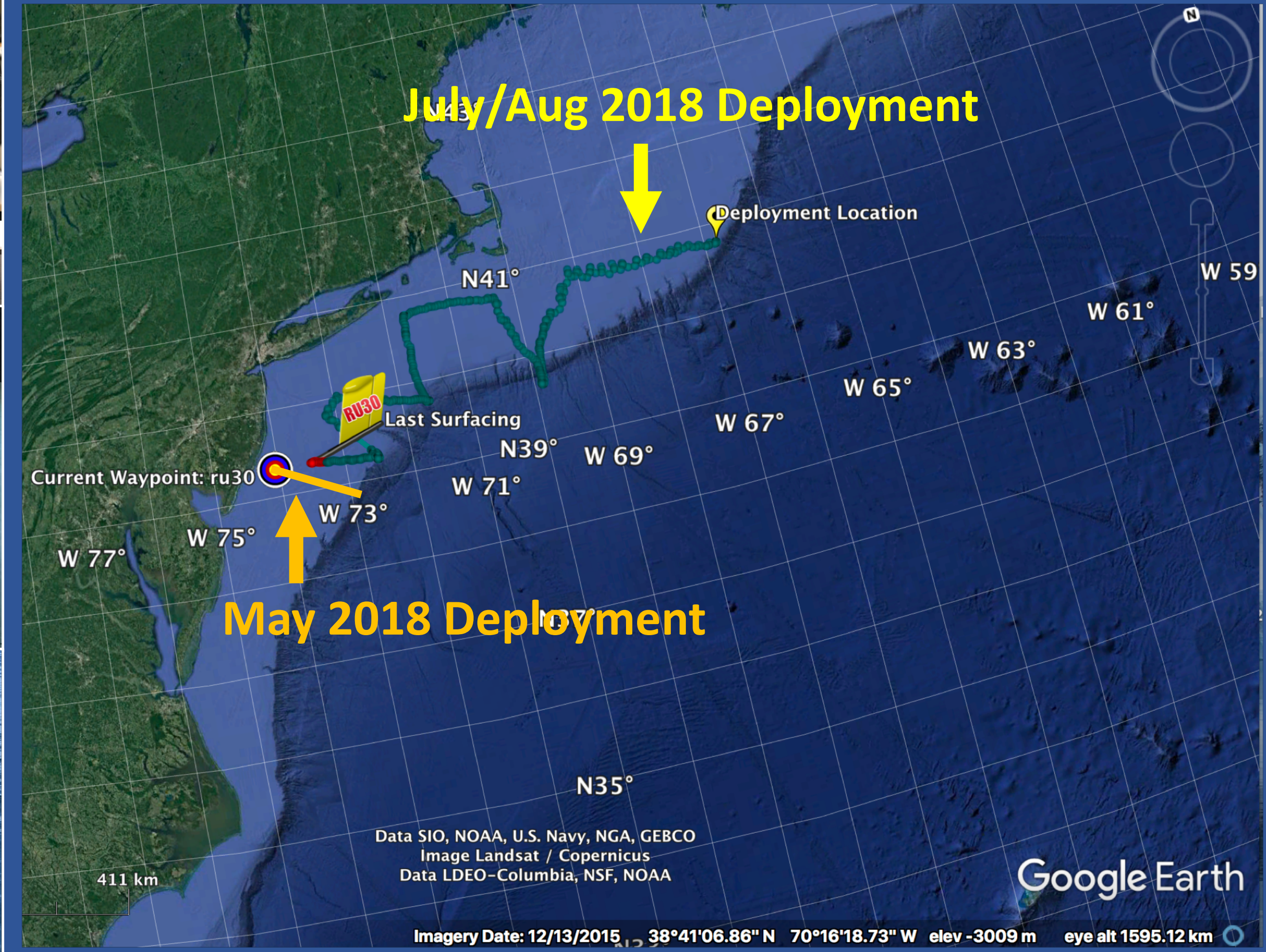


Tank Tests

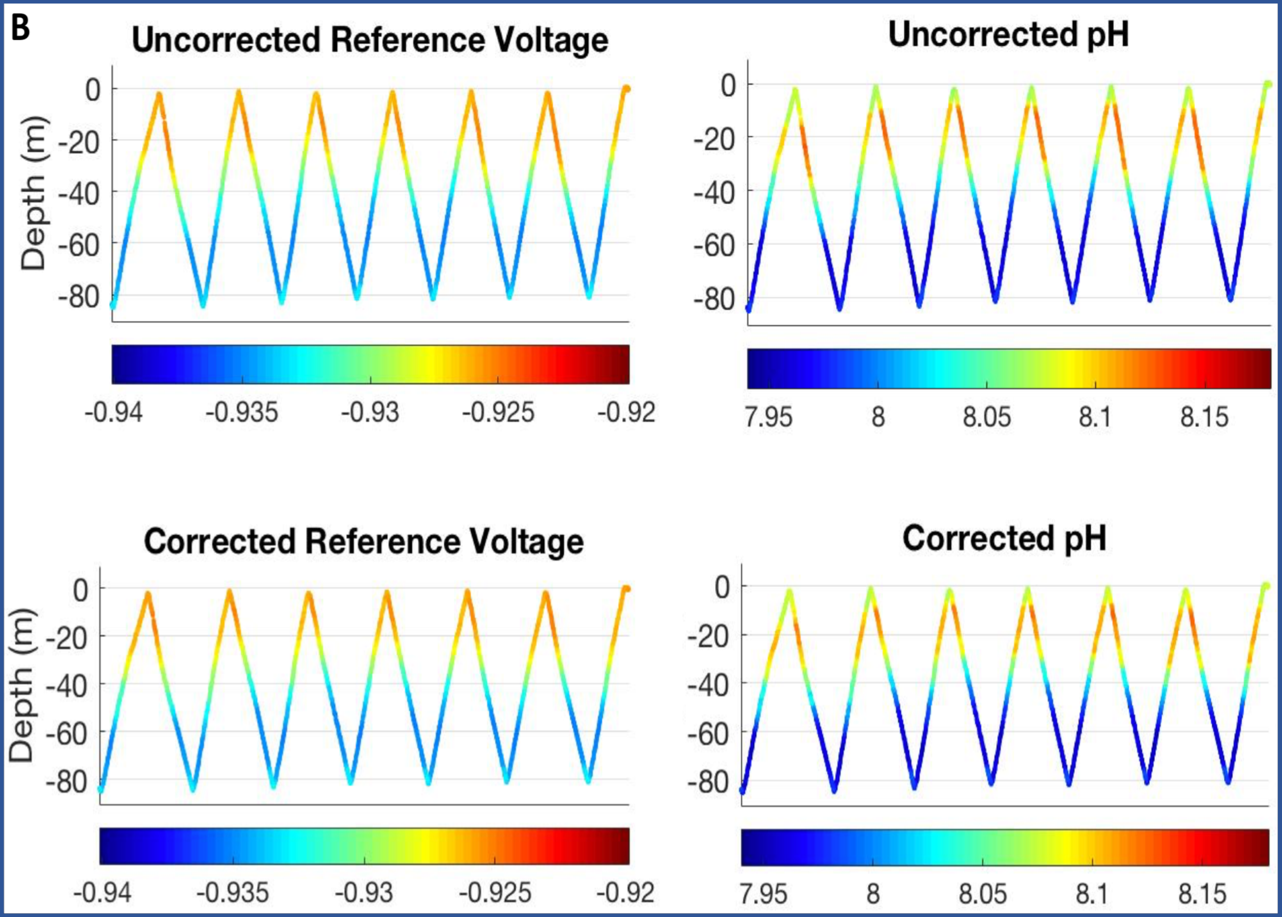


- Conditioning time: 4-6 days
- Sensor precision:
  - Tank: +/- 0.000-0.007
  - Field: +/- 0.000-0.055

First pH Glider Deployments

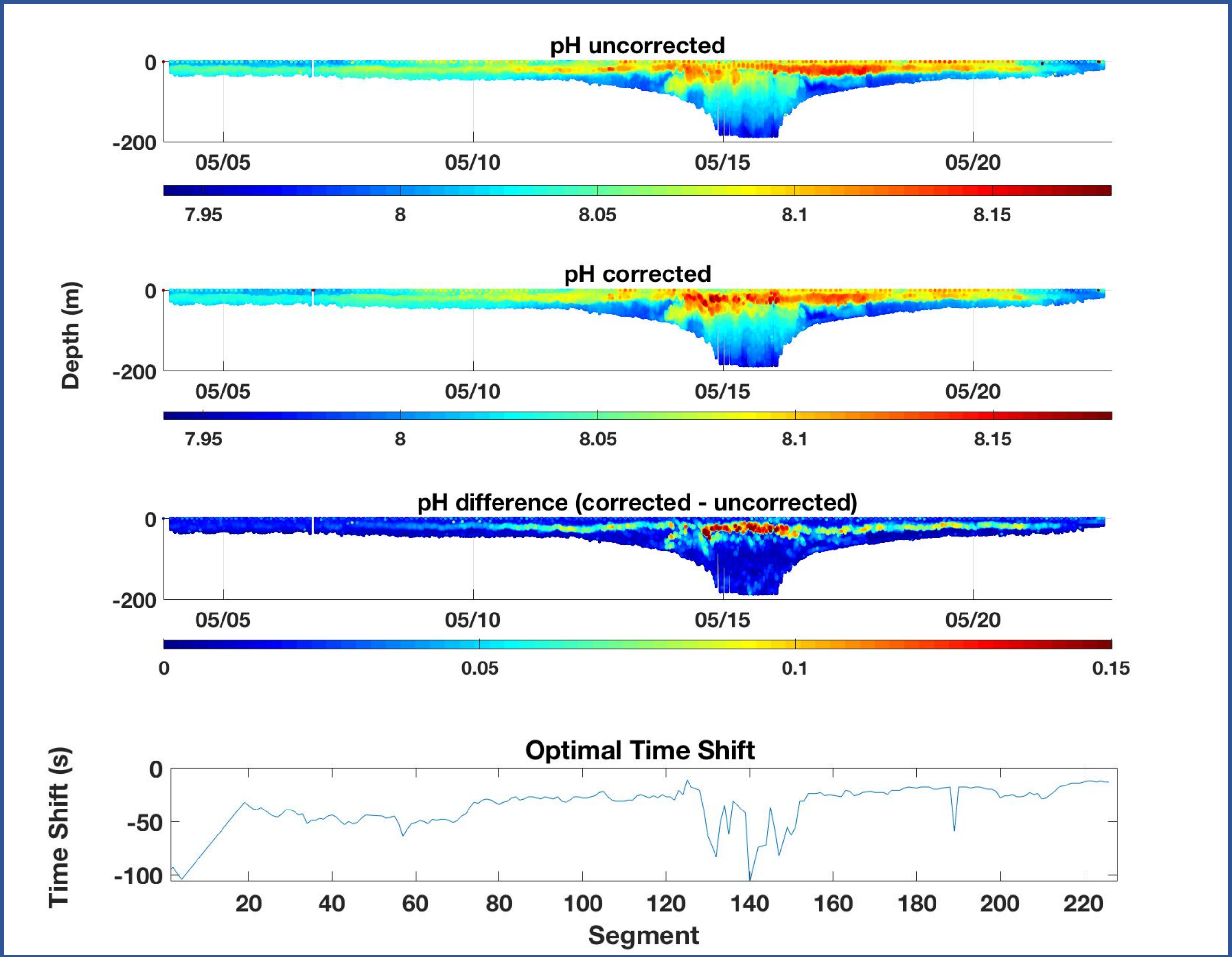


pH Response Time Lag



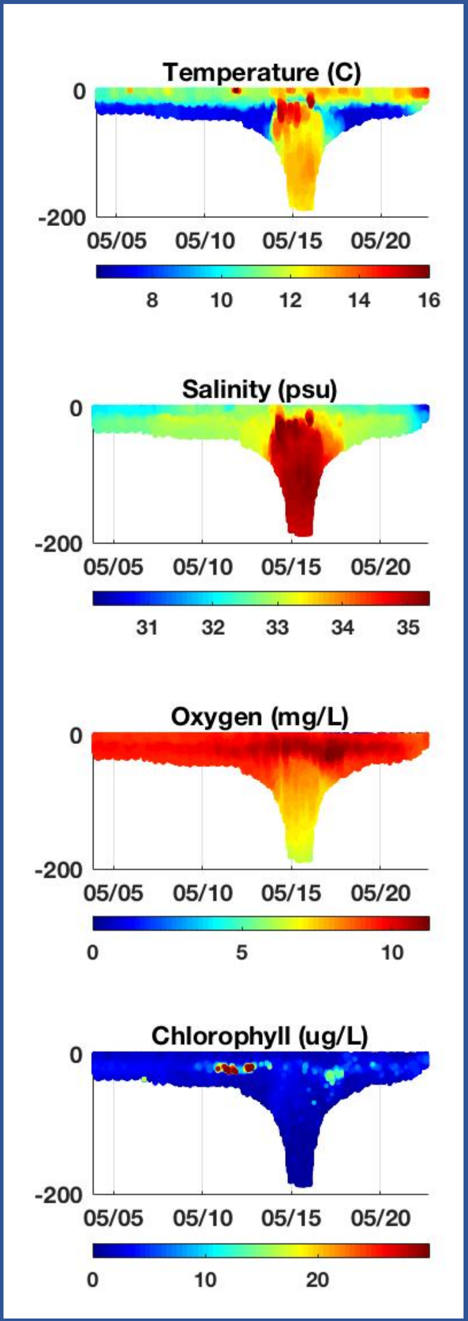
Corrected on an individual segment basis

pH Response Time Lag



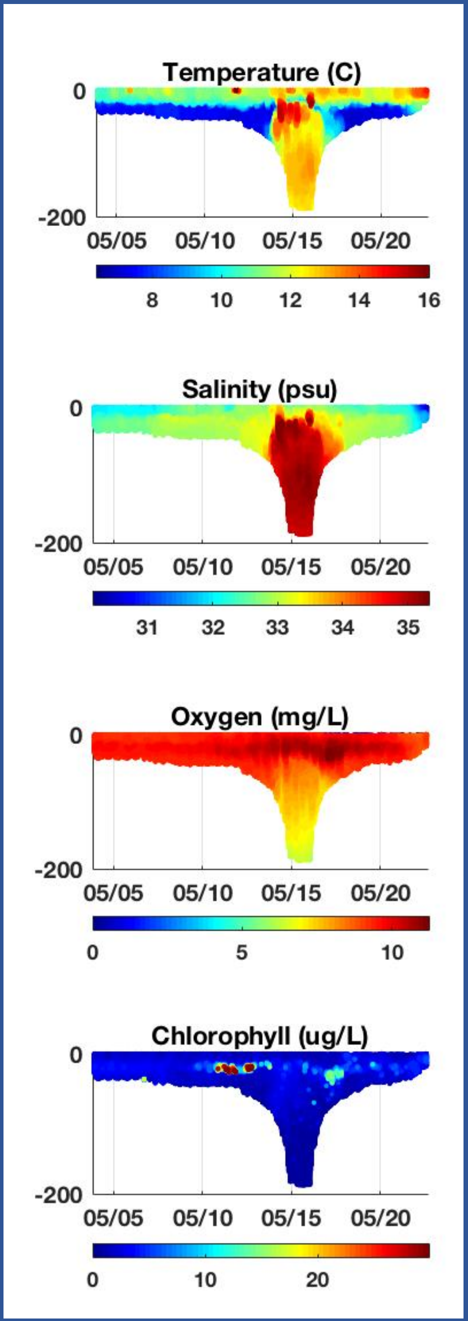
Cross Shelf Profiles

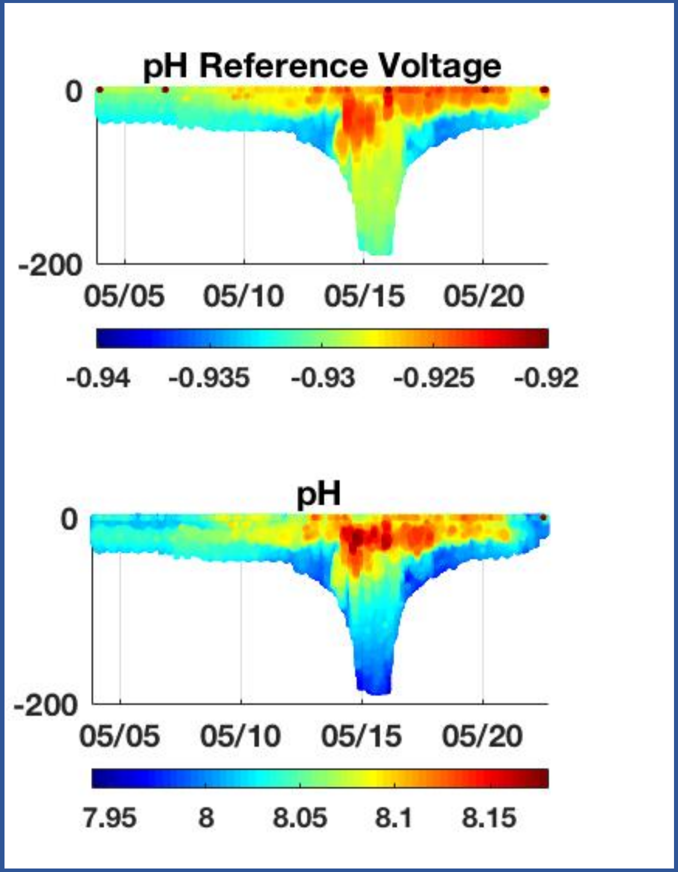
May 2018 – NJ cross-shelf



Cross Shelf Profiles

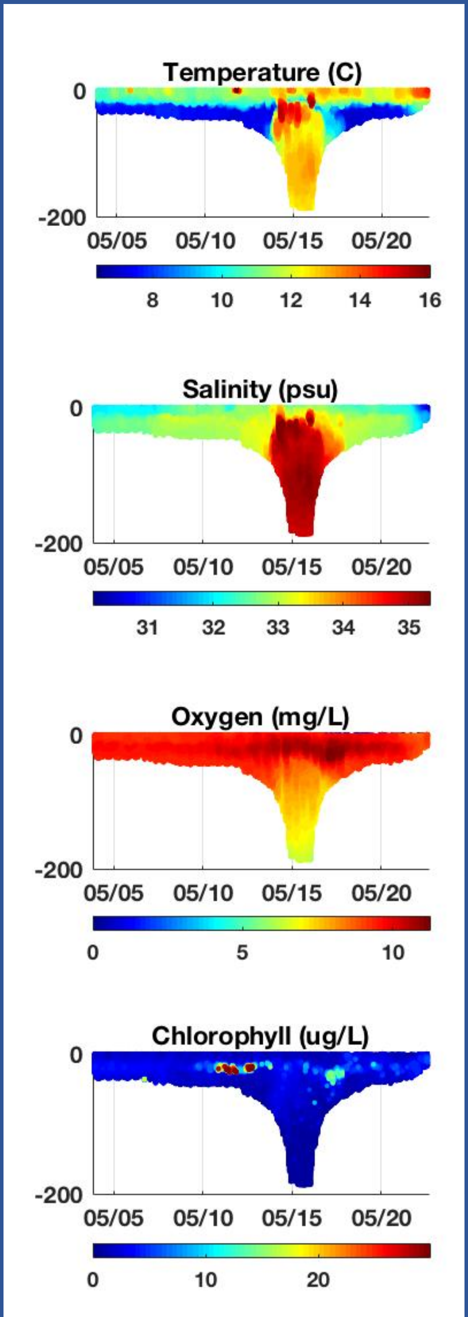
May 2018 – NJ cross-shelf

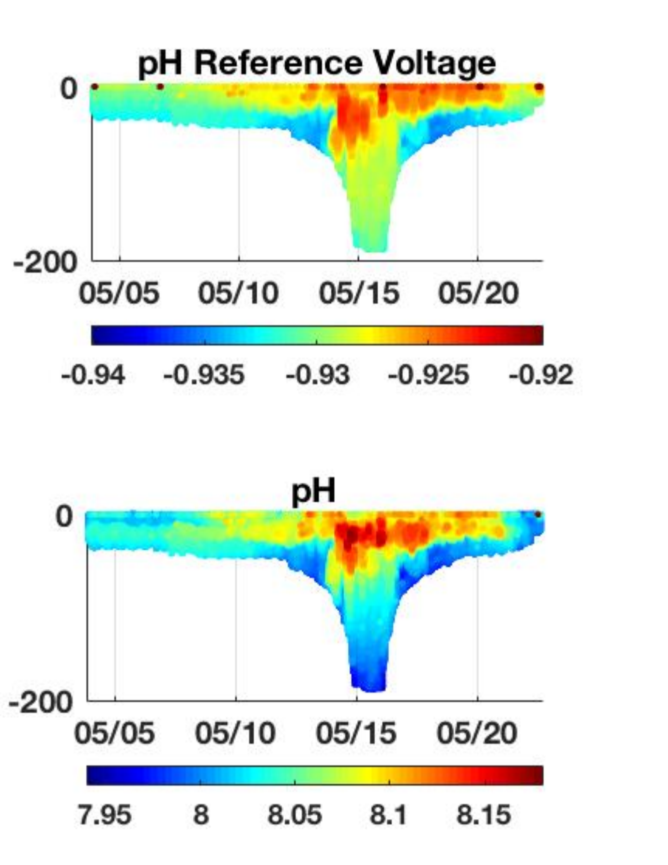


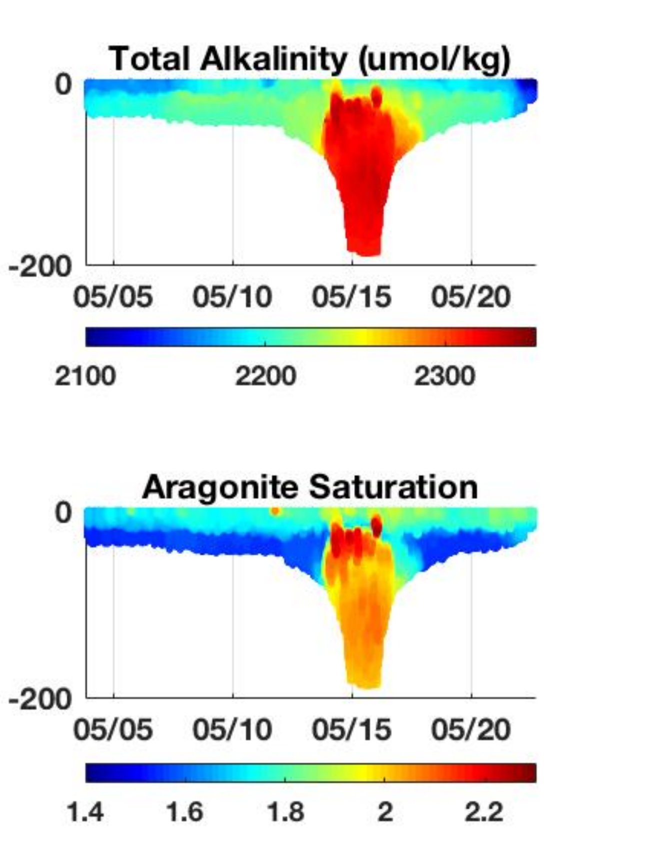


Cross Shelf Profiles

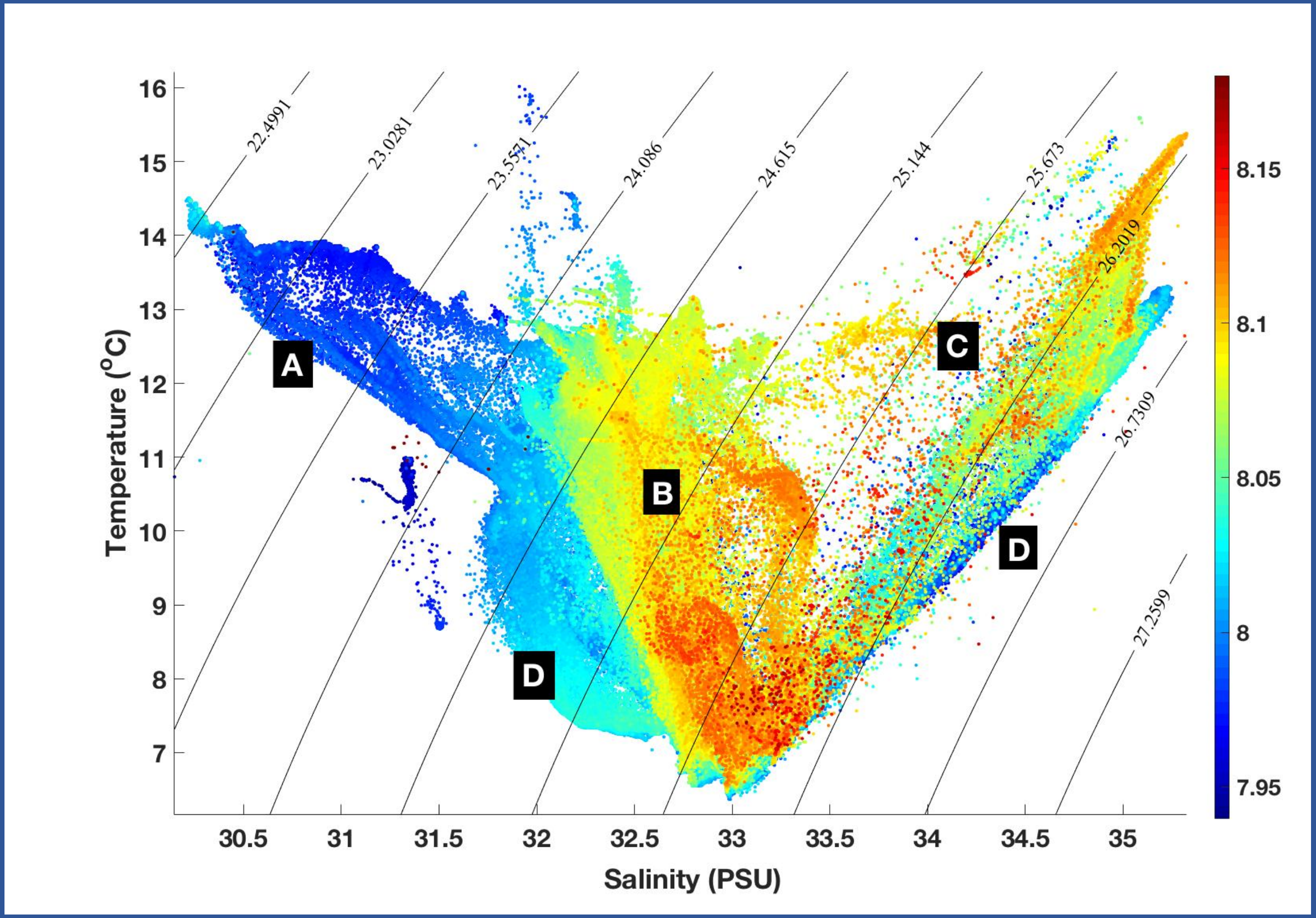
May 2018 – NJ cross-shelf







pH-Temperature-Salinity Relationships



A: Near-shore surface water

B: Mid-shelf surface water

C: Shelf break

D: Low pH bottom water (mid-shelf and shelf break)

Next Steps – Glider-Based OA Networks

Regional Level

PAPER

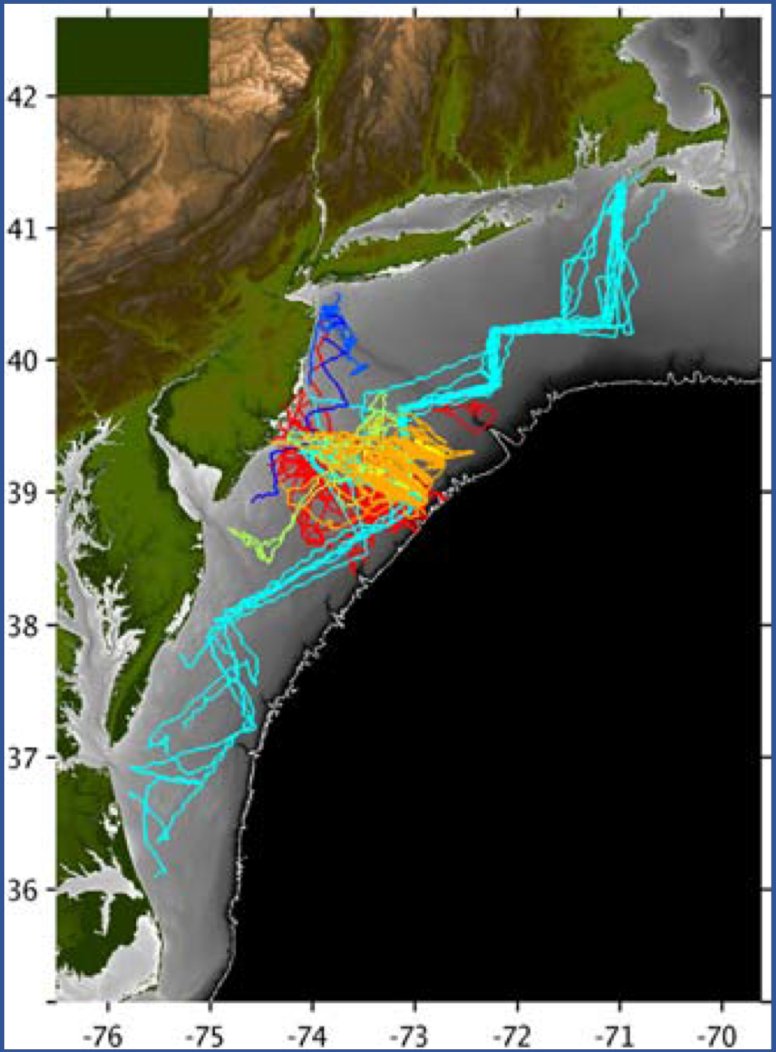
A Regional Slocum Glider Network in the Mid-Atlantic Bight Leverages Broad Community Engagement

Schofield et al. 2010, MTS

MARACOOS
Ocean Information for a Changing World

REGIONAL INFORMATION COORDINATION ENTITY CERTIFIED 2016

OOI
OCEAN OBSERVATORIES INITIATIVE



Next Steps – Glider-Based OA Networks

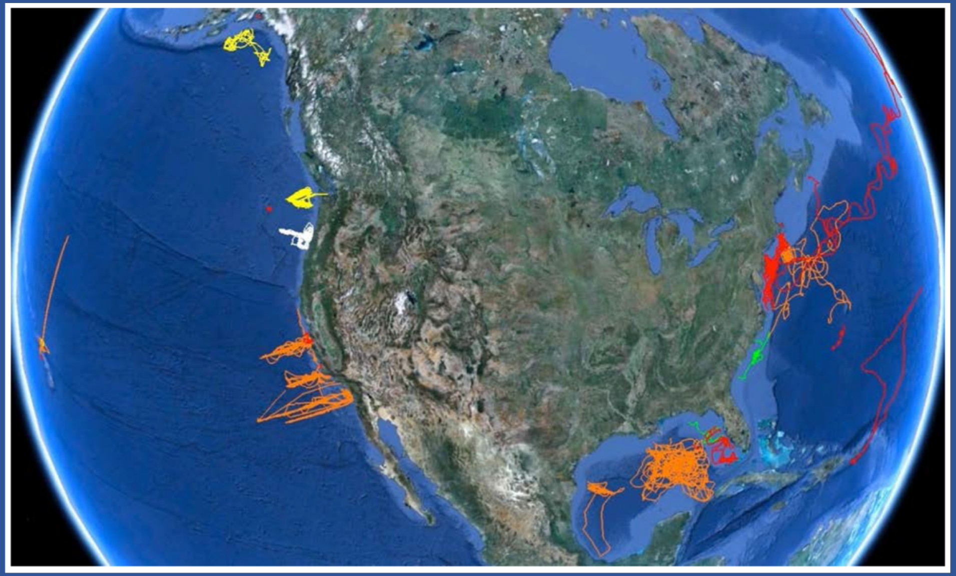
National Level

IOOS
Integrated Ocean Observing System

Toward a U.S. IOOS® Underwater Glider Network Plan:
Part of a comprehensive subsurface observing system

"Glider technology may be able to resolve some of the issues involved in measuring essential ocean variables like sea surface salinity, pCO_2, pH, nutrients, and phytoplankton biomass, health, and composition."

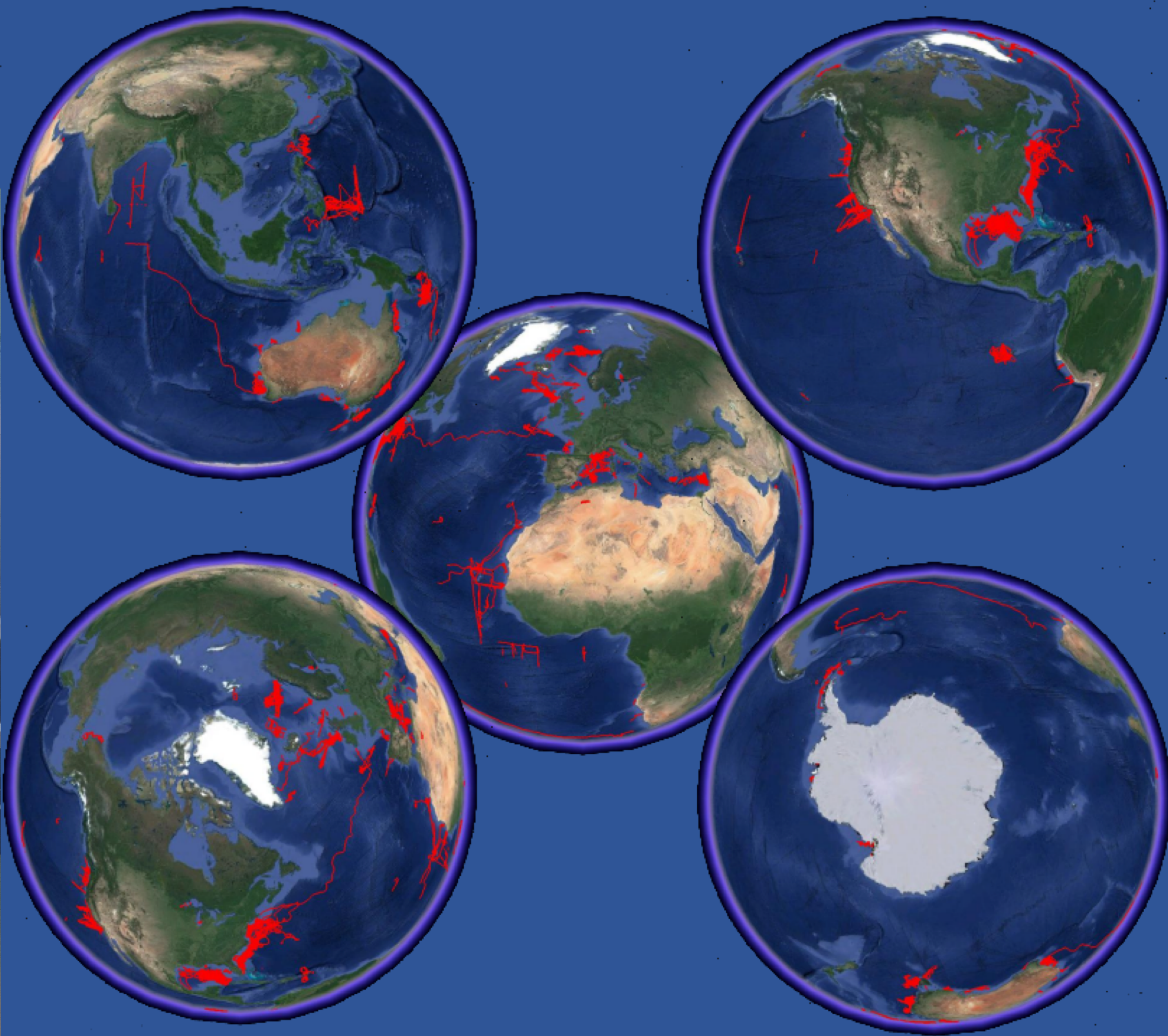
Glider tracks along the U.S. coast: 2002-2014



"As pH sensors mature, gliders will provide excellent platforms for monitoring ocean acidification."

Next Steps – Glider-Based OA Networks

Global Level



Testor et al., in prep Ocean Obs'19

Thanks!

saba@marine.rutgers.edu

NSF OTIC Program
(OCE #1634520)

MARACOOS
Ocean Information for a Changing World

REGIONAL INFORMATION COORDINATION ENTITY
CERTIFIED