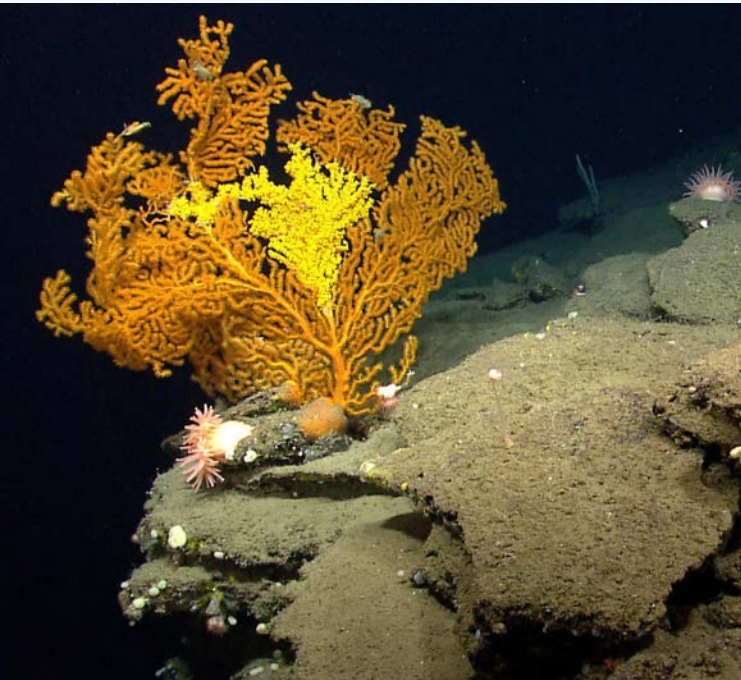


# Developing an Acidification Monitoring Plan in the Mid-Atlantic



**Sherilyn Lau, US EPA**

**Kaity Goldsmith, MARCO**

# MACAN Inaugural Workshop

- May 17, 2017 in Annapolis, MD
- Three breakout groups:
  1. Monitoring Plan → Monitoring Plan Workgroup
  2. Ecological Research Gaps → Research Priorities Workgroup
  3. Stakeholder needs and concerns



# Research Priorities Workgroup Summary

## Guiding Goals:

- Identify research gaps in the understanding of regional acidification impacts that will be used as a framework for researchers to focus future efforts
- Identify regionally relevant species to ecosystems vulnerable to acidification and to synthesize ecological impacts data

## Findings:

- Opposing responses within species, life stages, major groups etc.
- single species bench tests to in situ ecosystem studies
- Lack of large organism response
- Observe indirect effects beyond calcification
- Increase studies in MAB
- Need for realistic experimental design and enhanced techniques

# Why Develop a Monitoring Plan?

- Changes in ocean chemistry have the potential to create economic, environmental, social, and cultural impacts



## HEALTHY OCEAN ECOSYSTEM

**Action 3** - Develop a Mid-Atlantic Ocean Acidification Monitoring Network.

Changes in ocean chemistry have the potential to create economic, environmental, social, and cultural impacts in the Mid-Atlantic region. To

begin to understand ocean acidification and its potential impacts, a more comprehensive Mid-Atlantic Ocean Acidification Monitoring Network (Monitoring Network) that includes both coastal and ocean sampling sites is needed. This action will improve capacities to detect and understand ecosystem impacts of ocean acidification and enhance awareness within management agencies and stakeholders of select chemical and ecological changes in the ocean ecosystem. Partnerships with organizations like the **Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS)**,<sup>41</sup> a regional association of the U.S. Integrated Ocean Observing System, will help to ensure a coordinated regional approach to addressing ocean acidification in the Mid-Atlantic, as will drawing from experience in other parts of the Nation.

*Mid-Atlantic Regional Ocean Action Plan (OAP)*

*<https://www.boem.gov/Mid-Atlantic-Regional-Ocean-Action-Plan/>*



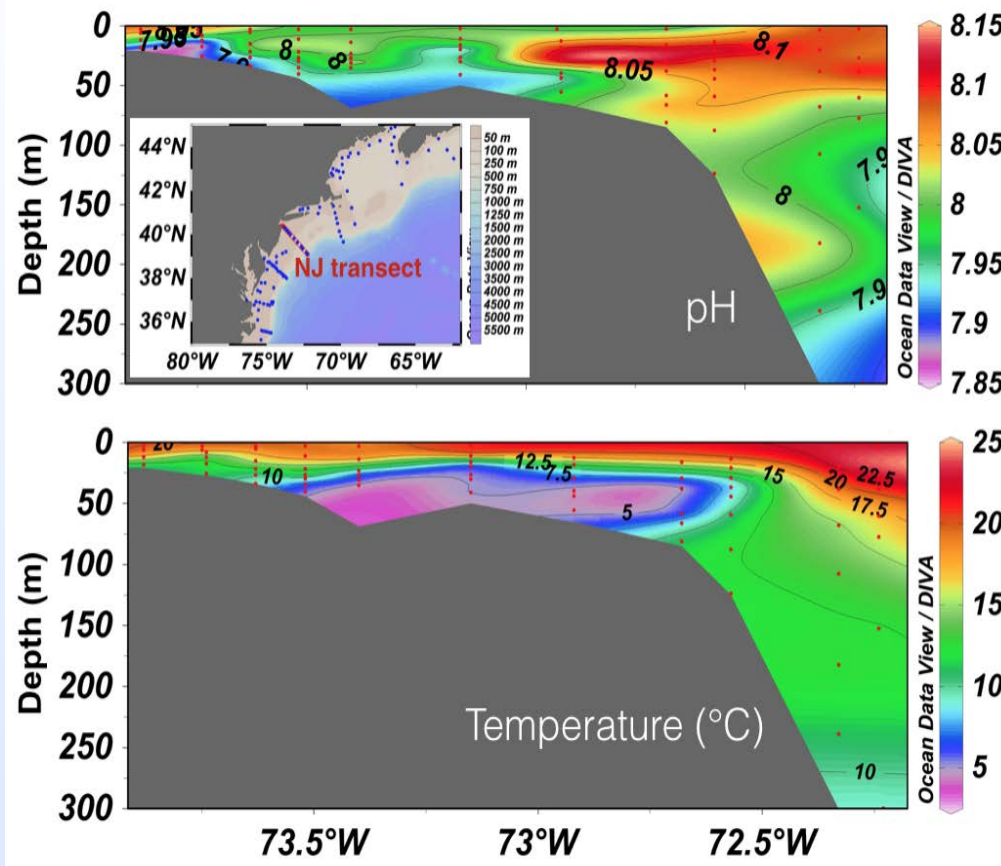
# Importance of Monitoring

- Establish a baseline
- Tracking environmental change
- Identify vulnerable habitats
- Provide a warning system
- Build and improve ecosystem models

Carbonate Chemistry Parameter	Abbreviation
Partial Pressure of Carbon Dioxide	pCO <sub>2</sub>
Potential of Hydrogen	pH
Dissolved Inorganic Carbon	DIC
Total Alkalinity	TA

# Ocean Acidification Conditions in the Mid-Atlantic

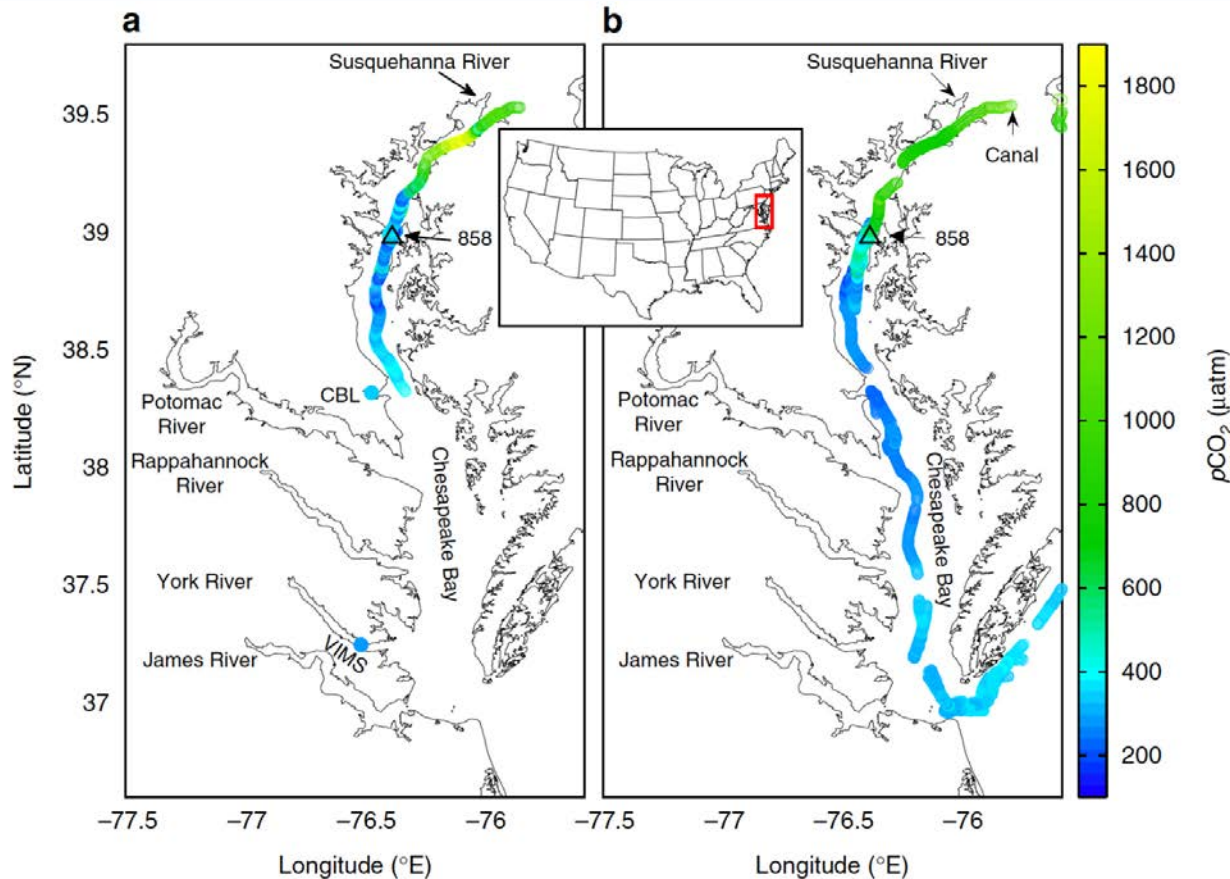
## Low pH in Cold Pool



“Ocean”  
Acidification

Ocean absorption  
of increasing  
atmospheric CO<sub>2</sub>

# Coastal Acidification Conditions in the Mid-Atlantic



## “Coastal” Acidification

Rivers and estuaries naturally acidic due to sediments, terrigenous materials, high productivity & respiration, and lower buffering capacity

*Cai et al. 2017*

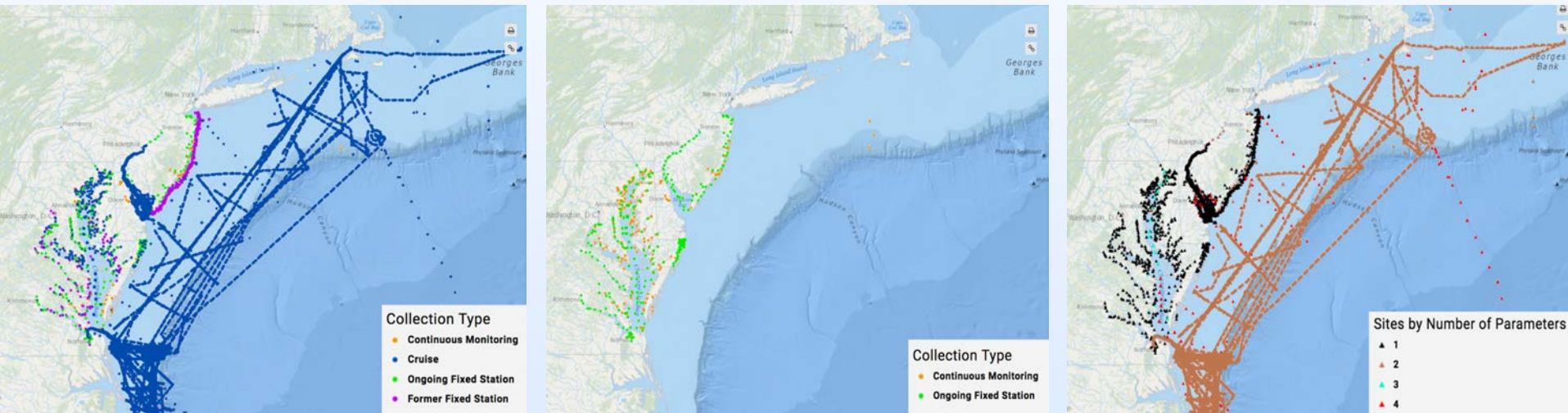
# Monitor Plan Work Group

<b>Name</b>	<b>Affiliation</b>
Kaity Goldsmith	MARCO
Sherilyn Lau	Environmental Protection Agency
Zhaohui 'Aleck' Wang	Woods Hole Oceanographic Institution
Mark Trice	Maryland Department of Natural Resources
Ryan Ono	Ocean Conservancy
Grace Saba	MARACOOS/Rutgers University
Matthew Poach	NOAA NEFSC
Laura McKay	VA CZM, MidA RPB, MARCO
Gregg P. Sakowicz	JCNERR, Rutgers University
Elizabeth Shadwick	VIMS
Janet Nye	Stony Brook University
Jennifer Draher	BOEM Office of Renewable Energy Program
A.J. Erskine	Bevans Oyster



# Monitoring Plan Work Group

*Works to develop a robust monitoring plan for the Mid-Atlantic region from estuary to open ocean in order to improve understanding of the carbonate chemistry variability and change in the region.*



*Static maps of monitoring in the Mid-Atlantic region. Left) all sampling; Middle) current sampling; Right) sites by number of carbonate chemistry parameters*

# Monitoring Plan Work Group

## Logistics and Organization

- Develop goals and an outline
- Decision made to present in white paper form
- Audience:
  - Target: Research community to fill in monitoring gaps
  - Summarize findings to stakeholders
  - Mid-Atlantic Regional Planning Body
- Volunteers to lead paper sections
- Monthly writing assignments and calls
- Routine edits on compiled working document
- Targeted completion in summer 2018

# Outreach Strategy

- By sharing information across this community about acidification and connecting industry partners with innovative technology and strategies for monitoring and adaptation, we seek to help industries prepare for and become more resilient to changing ocean conditions.
- MACAN has developed an outreach strategy to collect feedback from members and non-members to better serve those interested in the topic of acidification
- This strategy will help us target future webinars, website content, etc. to the questions and concerns most prevalent in the community
- Part of this strategy includes surveying a variety of industry communities. The purpose of the survey is to help MACAN identify what, if any, impact acidification is having on business operations, hear industry thoughts about opportunities the Network can provide to increase industry participation in regional efforts to monitor for and adapt to coastal/ocean acidification.

# Monitoring Plan Outline

- Existing monitoring
- Goals for the monitoring network
- Areas of high impacts
- Technology, water column location, and timing
- Optimizing current monitoring
- Building a robust network
- Multi-stressor monitoring
- Housing monitoring data

# Existing Monitoring in the Mid-Atlantic

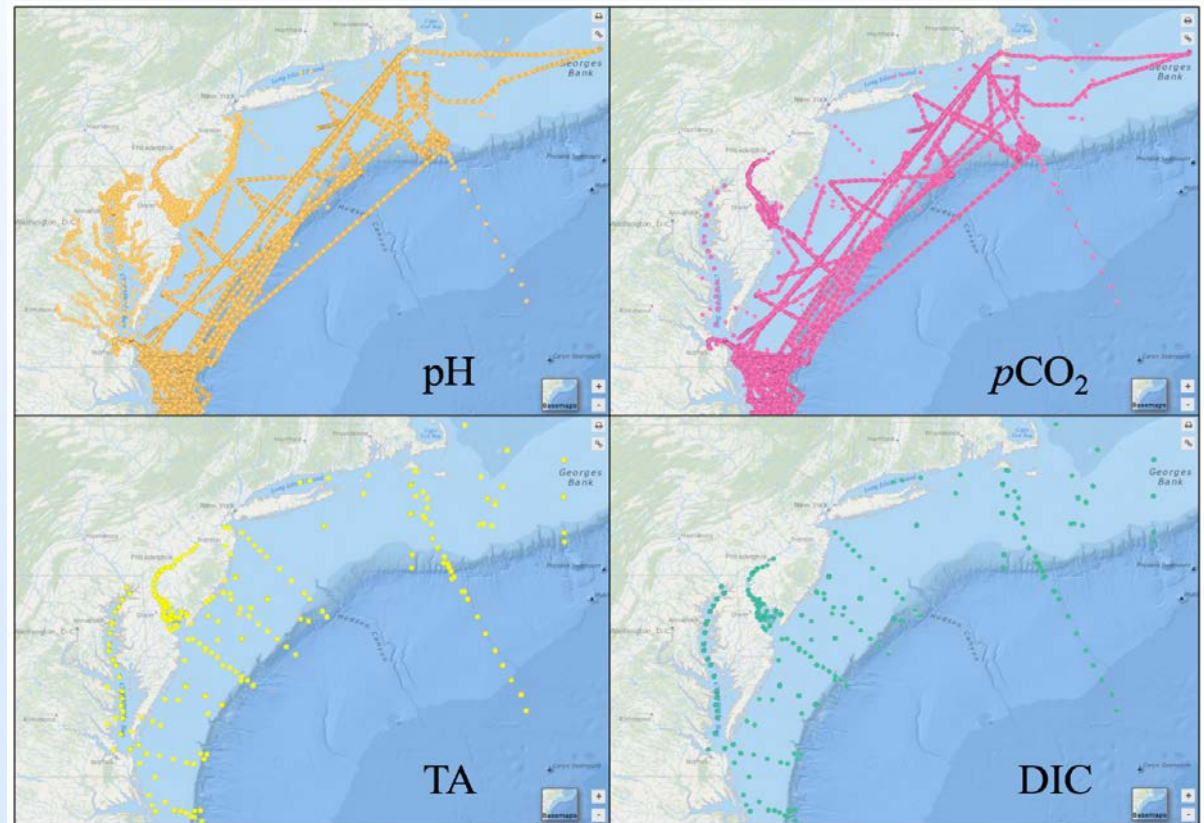


<http://portal.midatlanticocean.org/visualize/>



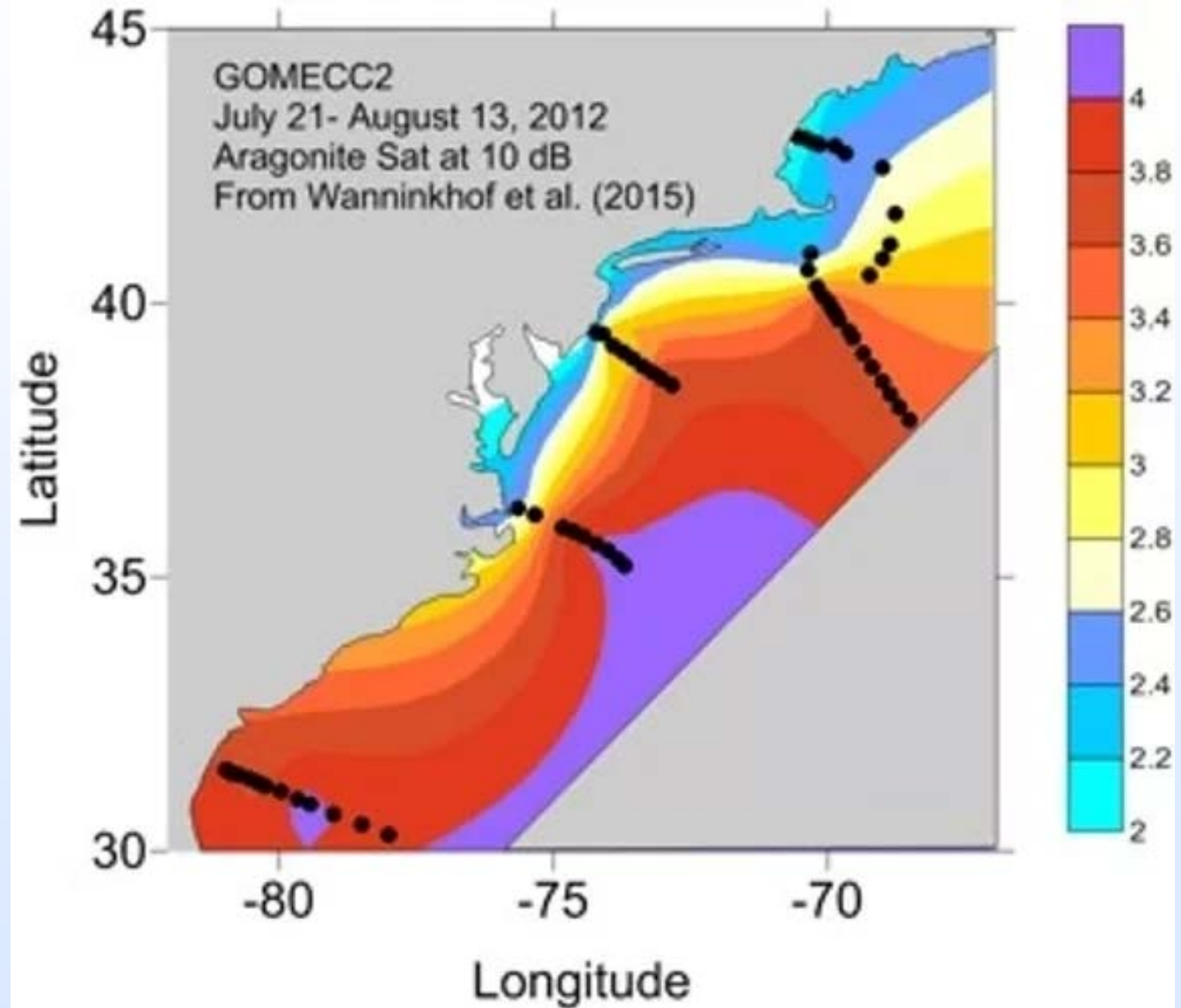
# Goals for a Monitoring Network

1. Capture the variations in estuarine to coastal to ocean acidification
2. Provide sufficient measuring of areas considered to be of “high impact”



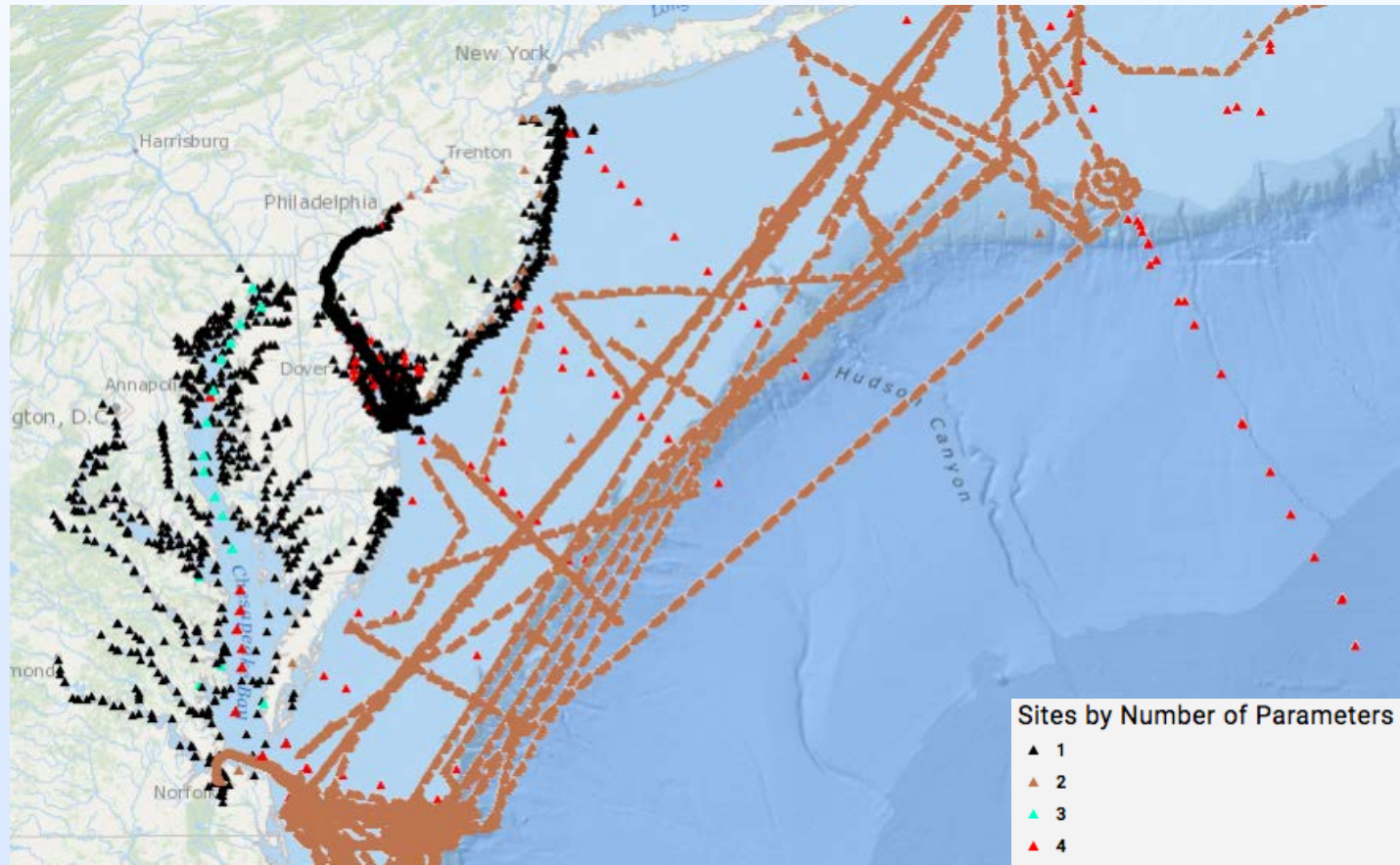
# Synthesizing What We Know

- Regional conditions

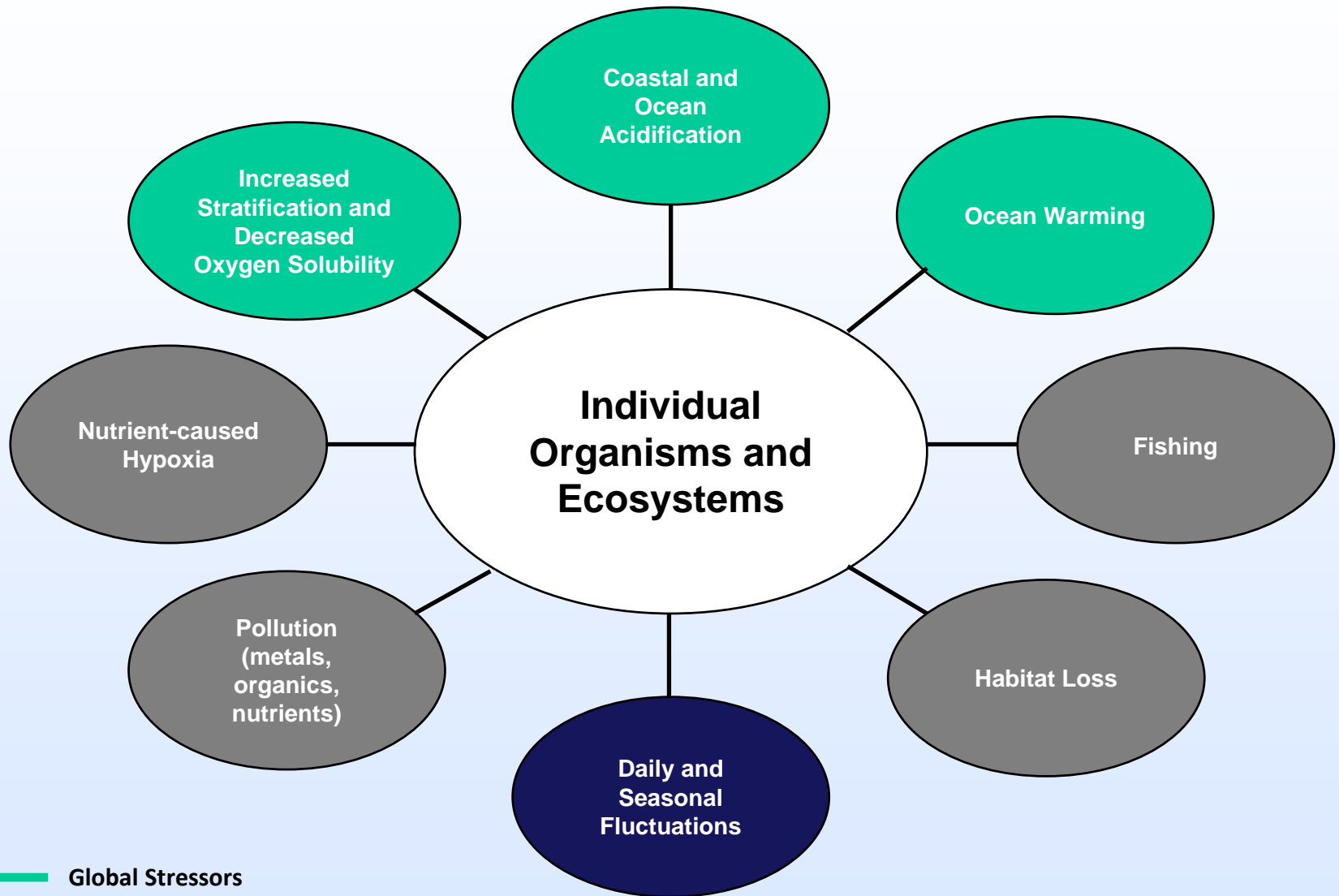




# Overarching Monitoring Gaps

- Low sampling frequency
- Need to optimize 1 parameter sites
- Need for high resolution depth-profiling



# Multi-Stressor

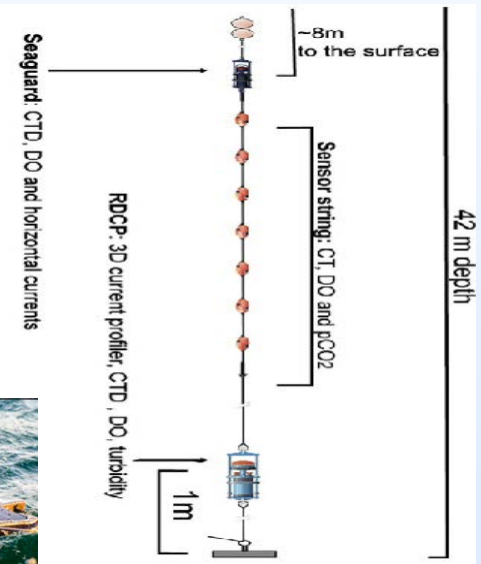
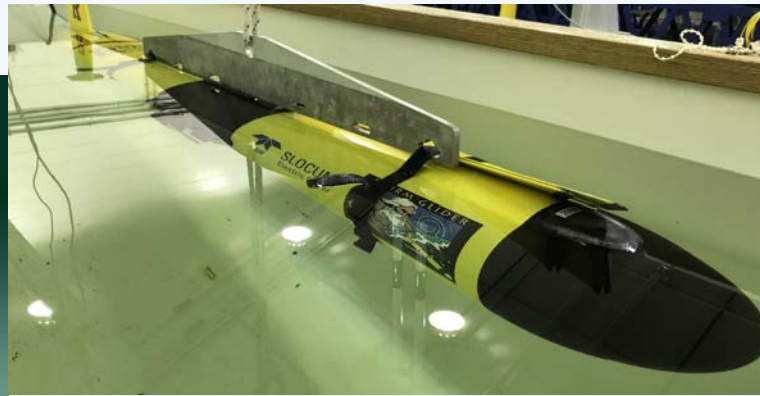


-  Global Stressors
-  Local Stressors
-  Natural Stressors



# Technology

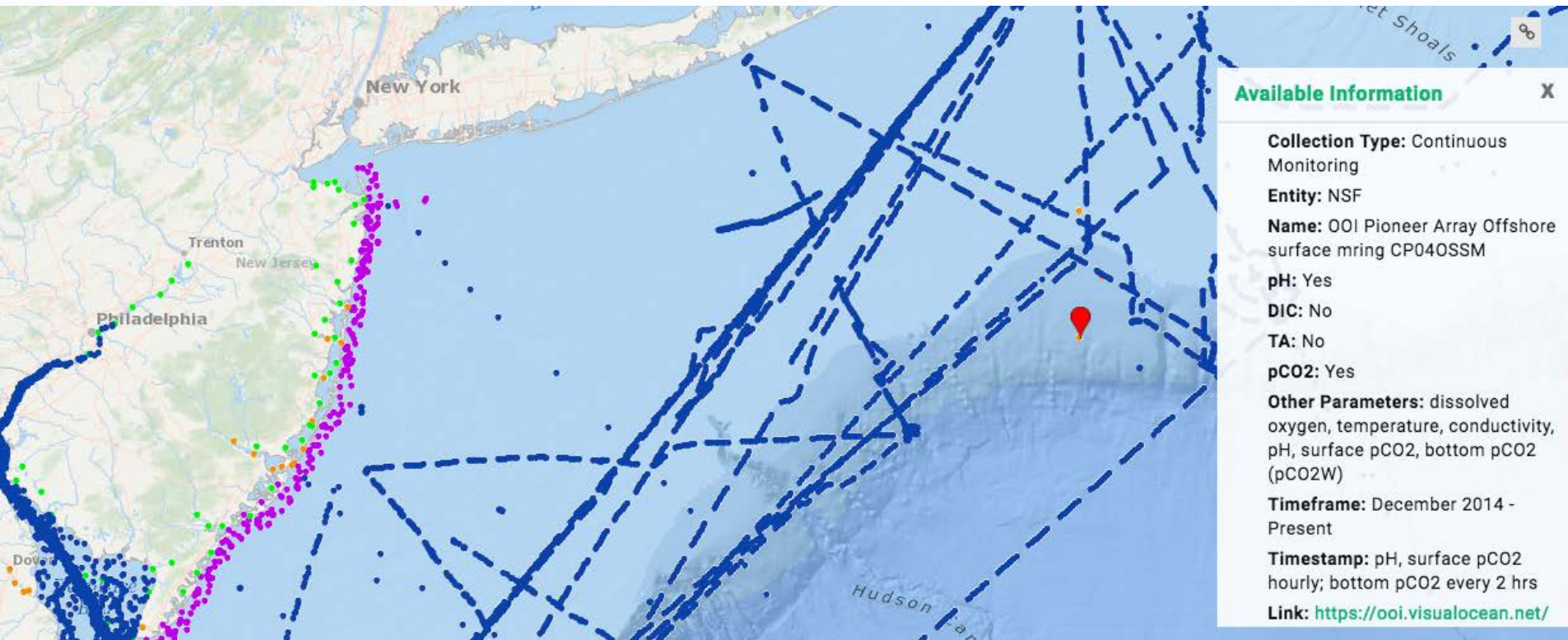
- Need:
  - High resolution sensors on depth profiling equipment
  - Cost-effective self-calibrating systems
  - Anti-fouling technology/methods



*Examples of existing technology: Left) Honeywell Durafet pH sensor; Middle Upper) deep ISFET pH sensor integrated into a Slocum Webb g2 Glider; Middle Lower) Liquid Robotics, Inc. Wave Glider; Right) Design of SeaGuard measuring node with sensor string (Atamanchuk et al. 2015)*



# Sample Frequency and Water Column Depth



<http://portal.midatlanticocean.org/visualize/>

# Monitoring Network Gaps

## General Concepts

- Resource limited/Optimization
- Consider tradeoffs
- Salinity gradient
- Identify proxy relationships
- Model incorporation

## General Locations

- Areas prone to acidification (i.e. upwelling, cold pool, northern latitudes, estuaries)
- Benthic/depth monitoring
- Shelf/coastal waters
- Open Ocean continuous
- Deep-sea canyons

# Specific Sites to...

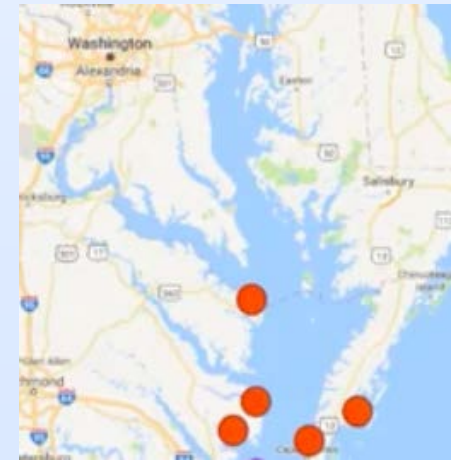
## Create/Optimize

- Shellfish hatcheries
- Mouth of the Delaware Bay/Little Egg Inlet off Long Beach Island
- CBIBS buoys
- NERRs/NEPs
- Continuous monitoring at depth in commercially relevant fishing grounds (such as sea scallop, ocean quahog, and surfclams)

## Maintain

- Oyster Sanctuary at Harris Creek
- 5 VA hatcheries
- Seagrass bed restoration off the seaside of Virginia's Eastern Shore in South Bay
- CBIBS with pH, DO, temp/ at the mouth of the Chesapeake Bay
- Chesapeake Bay sites with TA and DIC
- Pioneer array
- Cruises

*VA  
Hatcheries  
private-  
public  
partnership*



# Thank you!

Email [info@MidACAN.org](mailto:info@MidACAN.org)  
to become a MACAN member  
More information at [MidACAN.org](http://MidACAN.org)



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