SOCAN MONITORING WORKSHOP

Image credit: Lauren Valentino, NOAA/AOML

2/28/17

Workshop Report

SOCAN
Southeast Ocean and Coastal Acidification Network

SOCAN MONITORING WORKSHOP

IDENTIFYING PRIORITY LOCATIONS FOR OCEAN ACIDIFICATION MONITORING IN THE U.S. SOUTHEAST

SUMMARY

The Southeast Ocean and Coastal Acidification Network (SOCAN) held a workshop in Charleston, South Carolina to facilitate discussion on priority locations for ocean acidification monitoring in the Southeast. The discussion included identification of key gradients in physical, chemical and biological parameters along the Southeast coast, a review of current monitoring efforts, and an assessment of stakeholder needs. Sixteen monitoring locations were identified as potential acidification monitoring locations (*see page 12*). The following three monitoring locations were highlighted as priority sites that would further our understanding of the chemistry and regional drivers of ocean acidification and address stakeholder needs:

(1) Sapelo Island, GA

(2) Gulf Stream, offshore of Gray's Reef, GA

(3) Biscayne National Park, FL

The workshop concluded with a discussion of logistics and opportunities to pursue monitoring at the recommended locations. A copy of the agenda is included in Appendix 1.

PROCEEDINGS

Approximately 16 experts gathered for the SOCAN Monitoring Workshop to outline recommendations for priority ocean acidification monitoring locations in the Southeast (*Attendee List*, Appendix 2). The workshop began with introductory remarks regarding the structure and responsibilities of SOCAN and SECOORA. Following the introductory remarks, participants reviewed the proposed agenda; no modifications were made.

The first half-day was spent reviewing the state of ocean acidification science and regional response. Kim Yates shared a synthesis of the 2016 SOCAN State of the Science meeting, which included a review of webinars and key findings related to OA chemistry, modeling and organismal response. Following

the regional review, Leslie Wickes led a presentation and dialogue regarding stakeholder needs and how to merge these with scientific needs to prioritize monitoring locations. Next, participants reviewed the current monitoring asset list that was populated via online submission prior to the workshop. Participants discussed modifications to the *SOCAN Monitoring Inventory* approach and how best to proceed with the effort. The day concluded with an extensive review of biological, chemical and physical gradients along the coastal regions of the U.S. Southeast, from Florida (east and west coasts) to North Carolina. Participants reviewed the list of gradients and narrowed them down to priority gradients to consider for an OA monitoring approach.

The second day began with a review of material presented in Day 1 and synthesis of priority gradients to prepare for discussions of recommended locations. The participants then split into three groups to identify key gaps in monitoring and 3-5 proposed sites to fill these gaps. The breakout groups included those focused on chemistry, species response or stakeholder needs. Each group then presented their proposed locations and reasoning. Following a review of all proposed sites, participants voted on the three they considered highest priority. The highest priority sites were then discussed in detail, inclusive of feasibility, logistics and partnerships to pursue the proposed sites. The workshop concluded with development and review of an outline of a recommendation report for regional monitoring.

BACKGROUND

In 2016 SOCAN held a meeting to discuss the state of ocean acidification science, vulnerabilities and unique attributes of the U.S. Southeast Region. One of the priorities identified in this workshop was the need to address the lack of coastal monitoring. Previous research indicates multiple drivers of ocean and coastal acidification in the Southeast, highlighting the importance of regional dynamics (e.g. riverine input, Gulf Stream) that can mask the effects of atmospheric inputs of carbon dioxide on shorter timescales.

The Southeast currently lacks a cohesive monitoring approach and network. There are only two long-term OA continuous monitoring locations in the region- Cheeca Rocks in the Florida Keys (NOAA Coral Reef Conservation Program, NOAA Ocean Acidification Program) and Gray's Reef National Marine Sanctuary (NOAA Ocean Acidification Program), along with a few grassroots and research-driven efforts. While there are multiple water quality programs throughout the Southeast, these programs lack the ability to measure carbonate chemistry with the quality necessary to determine acidification impacts. Water quality and research programs throughout the region lack consistent methodologies limiting the data's utility for a cohesive network.

Attribution of acidification sources is critical in development of strategies for management and mitigation. Identification of acidification sources under limited resources requires a thoughtful approach, leveraging opportunities to coordinate monitoring efforts.

DAY 1:
REVIEW OF CONSIDERATIONS FOR MONITORING APPROACH

STATE OF THE SCIENCE

The state of ocean acidification science in the Southeast was reviewed in the 2016 SOCAN Workshop Report (Wickes, 2016). The key research priority identified in this workshop was to:

> *Measure key ocean acidification parameters (pH, DIC, TA, pCO2, temperature, DO, salinity, chlorophyll, nutrients) across various spatial and temporal scales to characterize the region and develop algorithms and indicators on relevant spatial and temporal scales for ecosystems.*

Key elements of this monitoring priority included establishment of baselines to work toward attribution of acidification sources; purposeful merging of physical, biogeochemical, organismal and ecosystem response; and development of algorithms to derive parameters of the carbonate system.

STAKEHOLDER NEEDS

Key stakeholders identified in the 2016 State of the Science Workshop included fisheries and the coral reef industry. While commercial fisheries in the Southeast are not as valuable as other U.S. regions, recreational fisheries rank the second highest behind the Gulf of Mexico. Value added of the recreational fisheries exceeds $3.8 billion with 84% considered residents of the region (National Marine Fisheries Service, 2016).

The proportionally high recreational fishery industry offers a unique challenge to stakeholder engagement where in many other regions commercial fisheries have been targeted. Additionally, the Southeast is the only U.S. region with expansive shallow-water coral reefs. The local sales impact of the Florida Keys coral reef tourism industry far exceeds that of fishing with at least $60 billion in local sales (recreational coral reef diving, fishing, viewing).

Important discussion points regarding stakeholders included:

(1) Engage stakeholders with a charge, not just as recipients of information

(2) Leverage and complement existing efforts so as to not overwhelm stakeholders

(3) Consider upstream stakeholders

(4) Identify and create an engagement plan for local tribes and Gullah-Geechee populations, many of which value shellfish resources economically or culturally

(5) Become a trusted source by providing technical assistance

Citizen science has been a tool increasingly used to engage stakeholders, but has been difficult to utilize in ocean acidification research given the technical difficulties of measuring the carbonate parameters. To overcome these issues, it was proposed to utilize the network of marine laboratories that could provide the training and tools necessary to measure carbonate parameters at the accuracy necessary for ocean acidification.

SOCAN MONITORING INVENTORY

Prior to the workshop, SOCAN conducted a survey of current ocean acidification monitoring locations. The request for submissions was distributed to the SOCAN Steering Committee, workshop participants and the SOCAN listserv. The submissions were collected and mapped; the preliminary inventory was reviewed at the workshop. Participants added additional locations to the map that were considered prior to moving forward with proposing new locations.

Participants then discussed the future of the Monitoring Inventory effort and established that the inventory will be integrated into ongoing SOCAN web portal efforts. Initial efforts will establish a metadata portal mapping the locations of stations that collect carbonate chemistry data. If and when data is included the data would be required to meet the standards set forth in the GOA-ON Requirements and Government Plan (2014) for carbonate chemistry, limiting the input of potentiometric pH data from many coastal water quality assessments.

SOCAN will carefully consider the end-user in creating a portal and also avoid duplication of efforts by potentially mirroring the existing GOA-ON portal at a regional level.

SOUTHEAST GRADIENTS

The workshop sought to establish and synthesize the key biological, physical and chemical gradients that occur along the U.S. Southeast coast. Spanning sub-tropical to tropical climates, a broad range of conditions result in a diversity of habitats ranging from coral reefs to brackish estuarine systems.

The following gradients were reviewed and considered (Table 1). Parameters in bold were selected as those of highest priority to consider for a monitoring approach.

Table 1: Gradients of coastal Southeast parameters considered for an OA monitoring approach

Chemical	Biological	Geographic	Physical
Air temperature **Sea surface temperature (SST)** Total annual precipitation River water (coastal acidification contribution) Carbonate platform presence **Change in nitrogen flow** Phosphorous Seafloor dissolved oxygen Surface chlorophyll-a **Aragonite saturation (surface and at depth)** Hypoxia presence **Estuary eutrophic score** pCO_2 pH DIC DOC **Salinity**	Salt marsh abundance Sea grass distribution Mangrove distribution Hard bottom essential fish habitat (EFH) Shrimp EFH Golden crab EFH Spiny lobster EFH Coastal pelagics (EFH) **Coral reef distribution** **Eastern oyster distribution** **Cold-water coral distribution** Species migratory routes Phytoplankton, Bacterioplankton Zooplankton	Population density **Population change** **MPA and NEP locations** Economic sensitivity Adaptive capacity Land use change Fishing permits and licenses	Karst topography **Upwelling presence** Tidal cycles Sea level rise Bathymetry Storm occurrence **Circulation (Gulf Stream location)** Atmospheric winds

During discussions of monitoring approach, the careful selection of indicator species was highlighted, noting that prior to conclusive research on OA effects on Southeast oysters, their use as an indicator species should be approached cautiously. Pending further investigation, oyster habitat will be considered in the monitoring approach, but not conclusively as an OA indicator for the Southeast.

DAY 2:
IDENTIFICATION OF PRIORITY MONITORING LOCATIONS

Following review of Day 1 findings and Day 2 objectives, participants split into three groups to identify gaps and priorities for monitoring. The groups consisted of those focused on key species, chemistry and stakeholder needs.

Findings from Breakout Group 1, Chemistry & Modeling:

Participants: Kim Yates, Chris Langdon, Scott Noakes, Ryan Moyer, Ruoying He

The goal of Chemistry & Modeling Breakout Group was to identify locations that would support validation of models and discern attribution sources of acidification. The group sought to capture the effects of upwelling, Gulf Stream flow and riverine contribution on the carbon budget.

Priority Sites identified by the Chemistry & Modeling Group:

- Pulley Ridge (Station 42097)
- GOM Loop Current (Station 42003)
- Diamond Shoal (Station 41025)
- Oculina and Cold-Water Reefs off Florida
- Albemarle-Pamlico Sound
- Tampa Bay
- Sapelo Island LTER
- Guana Tolomato Matanzas NERRS

Findings from Breakout Group 2, Key Species:

Participants: Lou Burnett, Emily Hall, Leslie Wickes, Janessy Frometa, Lauren Valentino

Group 2 sought to identify sites that provided key habitat to economically important species, particularly those considered potentially vulnerable to ocean acidification. Additionally, the group strategized to use paired sites that might elucidate multi-stressor effects on species, such as OA and harmful algal blooms (HABs) or OA and eutrophic score.

Priority Sites identified by the Key Species Group:

- Charlotte Harbor (high eutrophic score, high HABs)
- Suwanee River (low eutrophic score, high HABs)
- Albemarle-Pamlico Sound (high eutrophic score, low HABs)
- North Inlet-Winyah Bay NERRs (low eutrophic score, low HABs)
- Oculina Banks
- Lower Florida Reef Tract
- Upper Florida Reef Tract/Biscayne National Park
- Sapelo Island

Findings from Breakout Group 3, Stakeholder Needs:

Participants: Libby Jewett, Debra Hernandez, Brian Rappoli, Anna Toline, Paula Keener, Jennifer Vreeland

Group 3's goal was to identify monitoring sites that would both fulfill the needs of stakeholders and provide strong stakeholder support for outreach efforts. The group identified entities that would enable leveraging of outreach efforts. These entities included the U.S. National Park Service, National Estuarine Research Reserves, National Estuary Programs study areas (NEPs), NOAA National Marine Sanctuaries, and aquariums. The group also evaluated sites with key stakeholders, such as the coral reef industry and shellfisheries.

Priority Sites identified by the Stakeholder Needs Group:

- Biscayne National Park
- Sapelo Island
- Albemarle-Pamlico Sound
- Charleston Harbor
- Apalachacola Bay, FL
- Rookery Bay, FL
- Tampa Bay, FL

PROPOSED PRIORITY MONITORING LOCATIONS AND JUSTIFICATIONS

#1-10 listed in order of priority votes

1. **Sapelo Island, GA**

   Justification:

   Sapelo Island, GA is an existing Long Term Ecological Research (LTER) site. The site is inshore of Gray's Reef National Marine Sanctuary, where there is currently an ocean acidification mooring. The site would provide key insight to identification of, and attribution to, sources from estuarine inputs. With the addition of an offshore Gulf Stream Buoy (see below), the onshore-offshore transect would contribute to our understanding of the carbon budget, revealing effects of riverine inputs and Gulf Stream meandering. Sapelo Island also has the stakeholder Sapelo Sea Farms, a shellfish farm run by SOCAN Steering Committee member Charlie Phillips. The site would offer a potential test bed for stakeholder monitoring and engagement efforts.

   Logistical considerations and opportunities:

   - LTER Site
   - Scott Noakes (UGA and SOCAN Steering Committee & Charlie Phillips (Sapelo Sea Farms and SOCAN Steering Committee) engaged and interested in OA efforts
   - Potential collaboration with efforts to establish user-friendly carbonate chemistry sensor equipment

2. **Gulf Stream Buoy, Off-shore Gray's Reef, GA**

   Justification:

   With the addition of a Sapelo Island station, a new Gulf Stream Buoy would complete an onshore-offshore transect of ocean acidification monitoring and address model validation needs. This site would fill a critical gap that would provide insight on the Gulf Stream contributions toward acidification attribution, including longitudinal changes to the current and its influence on upwelling.

   Logistical considerations and opportunities:

   - New buoy unlikely in the near future due to cost limitations
   - Potential use of NOAA National Marine Sanctuary vessels for maintenance could reduce costs

- Though a continuous monitoring station may be a far-future possibility, there may be opportunities to begin opportunistic sampling targeting temporal upwelling

3. **Biscayne National Park, FL**

   Justification:

   Biscayne National Park is just south of the northern most areas of the Florida Coral Reef Tract where, according to recent research, reefs experience seasonal dissolution during fall and winter (Muehllehner et al. 2016). This marginal site for coral reefs would provide context to the higher quality reef habitat near the NOAA Cheeca Rocks buoy. Biscayne National Park site offers opportunities to leverage other monitoring efforts and for stakeholder engagement.

   Logistical considerations and opportunities:

   - Leveraging NOAA Atlantic Oceanographic Meteorological Laboratory (AOML), National Park Service and university network for monitoring activities and stakeholder engagement
   - Good location to spearhead a university-based citizen science initiative

4. **Florida Keys Lower Reef Tract**

   Justification:

   The Florida Lower Reef Tract in the Key West region has a high density of the Florida coral reef tourism industry. The site offers an established stakeholder network that could be paired with monitoring efforts. These reefs represent one of the most vulnerable habitats in the United States to ocean acidification; additional efforts, such as pore-water sampling, would contribute to ongoing efforts to understand the vulnerability of the Florida Keys reefs to OA.

   Logistical considerations and opportunities:

   - Leveraging AOML and extension of Cheeca Rocks operations and Phytoplankton Monitoring Networks could lower monitoring costs
   - Good region to utilize new lower cost technologies to engage a large stakeholder network

5. **Albemarle-Pamlico Sound, NC**

   Justification:

   The Albemarle-Pamlico Sound is a highly eutrophic estuary that would provide a test-bed for coastal acidification attribution identification. Economically important shellfish industries and local scientists at Duke University and University of North Carolina could potentially provide support for the monitoring effort and stakeholder engagement. The region has an OA sampling station at Pivers Island Coastal Observatory (PICO) that could be complimented by a continuous

monitoring station.

6. **Charleston Harbor, SC**
   Justification:
   Charleston Harbor has significant personnel resources including the SOCAN Program Coordinator, Director of SECOORA and South Carolina Sea Grant. The site offers utility in stakeholder engagement. Additional resources can potentially be leveraged through local universities and the SC Department of Natural Resources. SECOORA in partnership with SCDNR and NERRs are installing and new water quality station in the Charleston Harbor in 2017.

7. **Oculina Banks, FL**
   Justification:
   Oculina reefs are found along the shelf edge off the east coast of Florida at 60-100m depth. Low aragonite saturation (Ω_{arag}) waters impinge toward the surface from west to east, where the Ω_{arag} 1.5 contour reaches 75 m water depth along the shelf break. These depths and locations coincide with Oculina and deep-water reef habitat. These sites also coincide with the 2016-2019 Southeast Deep Sea Coral Initiative that could potentially be leveraged for OA sampling efforts.

8. **Diamond Shoal, Offshore NC**
   Justification:
   Additional OA sensors on an existing offshore buoy (NDBC41025) would provide an onshore-offshore transect from existing Pamlico Sounds efforts (e.g. PICO). The sensors would provide insight to effects of the Gulf Stream on OA parameters.

9. **East Florida Slope- Pulley Ridge**
   Justification:
   Adding OA sensors to the existing offshore buoy (NDBC42097) would capture the effects of the Gulf of Mexico (GOM) loop current on acidification at a relatively shallow site (~80m). Pulley Ridge is a mesophotic coral site that forms important habitat for grouper.

10. **GOM Loop Current**
    Justification:
    Adding OA sensors to the existing offshore buoy (NDBC42003) would capture the effects of the Gulf of Mexico loop current on acidification at a deep site (~3200m).

11. **Suwannee River, FL**
    Justification:
    The Florida region near the Suwannee River has relatively low human impact that could be used as a paired site with a eutrophic system. The region has a low population density but has a

significant shellfish industry. The region is frequently exposed to HABs, which would provide a paired site with the more-developed, but still HAB-exposed, Tampa Bay region.

12. **North Inlet-Winyah Bay, SC**

    Justification:

    This site is would act as a low-impact site paired with other eutrophic systems, such as the Pamlico Estuary just north. The sites are relatively similar regarding habitat and natural conditions, but differ in their eutrophic score. The region is a NERRs site, offering utility in set up and maintenance, and is also an important region for the shellfish industry.

13. **Apalachicola Bay** or (14) **Rookery Bay, FL NERRs**

    Justification:

    Either site offers the opportunity to work with a NERRs site to leverage the monitoring effort and stakeholder engagement. The region has a medium-high eutrophic score that could be paired with low eutrophic score NERRs sites.

15. **Charlotte Harbor** or (16) **Tampa Bay, FL**

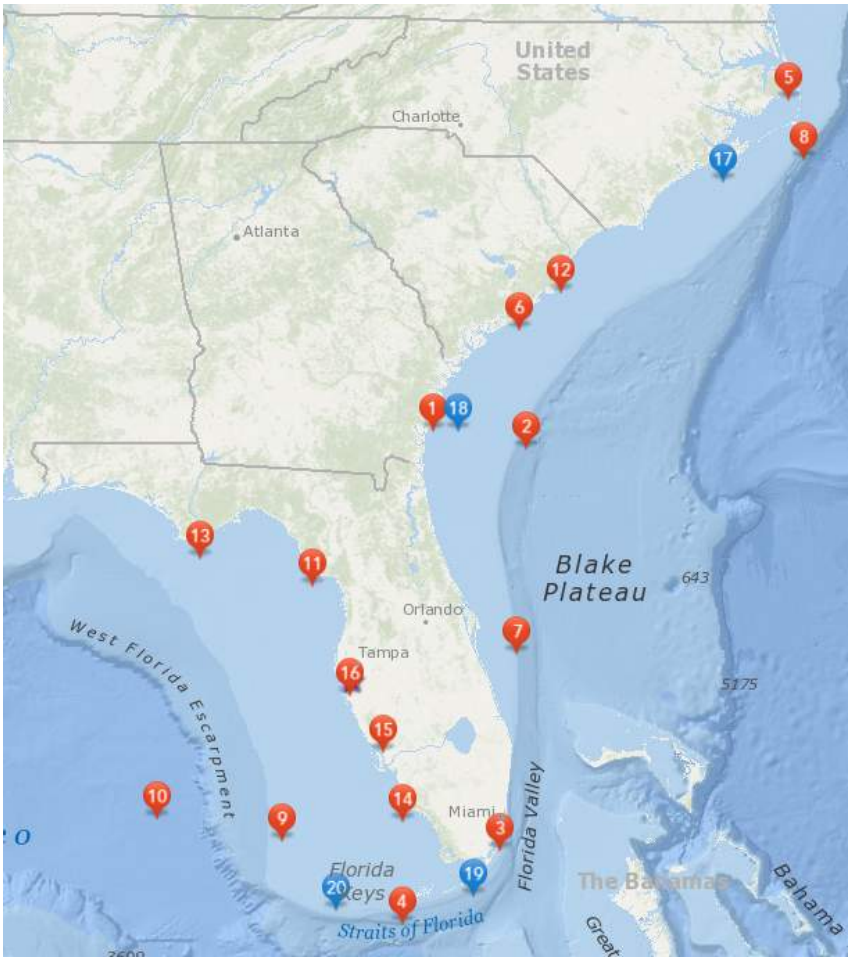
    Justification:

    These sites include highly eutrophic systems with high population growth, prevalent HABs, density of oysters and clams and nearby partners (e.g. Mote Marine Laboratory, National Estuary Program, U.S. Geological Survey). Seagrass restoration and new OA monitoring efforts would compliment a continuous monitoring system and capture potential affects of restoration.

Logistical considerations and opportunities:

- Leveraging USGS and Tampa Bay Estuary Program and extension of Tampa Bay OA research and monitoring operations
- Tampa Bay may be acting as an ocean acidification refuge

MAP OF MONITORING LOCATIONS



PROPOSED EFFORTS

1. Sapelo Island
2. Gulf Stream Buoy
3. Biscayne National Park
4. Lower FL Reef Tract
5. Albemarle-Pamlico Sound, NC
6. Charleston Harbor, SC
7. Oculina Banks
8. Diamond Shoal
9. Pulley Ridge
10. GOM Loop Current
11. Suwanee, FL
12. North Inlet-Winyah Bay, SC
13. Apalachicola Bay, FL
14. Rookery Bay, FL
15. Charlotte Harbor, FL
16. Tampa Bay, FL

17	Pivers Island Coastal Observatory (PICO)	DIC, pH	Weekly	Zackary Johnson, Duke University
18	Gray's Reef National Marine Sanctuary	pCO2, pH	3 hrs	NOAA Ocean Acidification Program Scott Noakes, University of Georgia Wei-Jun Cai, University of Delaware
19	Cheeca Rocks	pCO2, pH	3 hrs	NOAA Ocean Acidification Program NOAA Atlantic Oceanographic & Meteorological Laboratory (AOML)
20	Dry Tortugas	pCO2, pH	1 hr	Kim Yates, U.S. Geological Survey
10	Tampa Bay, FL	pCO2, pH,	1 hr	Kim Yates, U.S. Geological Survey

	Implementation Underway	DIC, TA		

CURRENT EFFORTS

SOCAN OA MONITORING APPROACH WHITE PAPER OUTLINE

1. Needs (science and stakeholders)

- Science
  - Evidence that coastal acidification is already occurring and at very rapid rates
  - Some species are already affected (corals, potentially shellfish)
  - Many gaps
  - Unique region
  - State of the science key findings and guidance for developing regional OA monitoring activities
- Stakeholders
  - Socioeconomics very driven by vulnerable habitat and species

- Commercial and recreational vulnerabilities, cultural vulnerability, vulnerability risks from coastal hazards
- Many protected areas – management needs for protection, restoration, mitigation, etc.
- Very little information exists to inform vulnerability assessments

2. Complexities

- Many and extreme gradients across region
- Basic OA chemistry driven by many gradient factors
- Multi-stressor factors are many and complex
- Spatial and temporal gradients further confound multi-stressor impacts

3. Gradients

- Gradients description
- How we use gradients as natural laboratories (opportunity)
- Models to fill gaps in observations
- Key targeted gradients in our region (climate, upwelling, freshwater inflow, eutrophication, etc.)

4. Strategic and priority locations

- List of all locations prioritized by science and management needs along with text for justification
- Discussion of 'low hanging fruit' with respect to partnership/collaborative activities
- Identified logistical needs for specific locations (e.g. trackline cruises in estuaries versus offshore buoys, etc.)

5. Approach

- Partnership and collaborative opportunities, examples discussed for top three sites. This is an approach that should be implemented when considering additional locations.
- Creative efficiencies, developing university collaborations to incorporate OA monitoring in undergraduate/graduate curricula for higher level citizen science and student educational opportunities. Also consider utilization of student interns and volunteers.
- Tiered approach: would like to continue and add buoy locations. Especially in estuaries, if no buoys exist, should start with discrete sampling to provide baseline data, inform model validation, and determine need and location for buoy ops. For offshore, buoys are ideal, but event targeted (e.g. Gulf stream meandering) discrete sampling (vertical) before, during and after events would be useful to inform modeling and begin filling gaps. In some areas, like Florida Keys, there is good OA monitoring but other data gaps that need to supplement OA monitoring (e.g. pore water DO as related to nutrient driven carbonate dissolution).

6. Recommendations (toward implementation)

7. Next steps (toward implementation)

I. APPENDIX I: AGENDA

Objectives:

- Identifying key locations (possibly sentinel or priority sites) to begin filling monitoring gaps;
- Outline an approach for developing OA monitoring sites that will expand existing efforts; and
- Begin assessing how to cost-effectively monitor the chemical variability along the diverse physical, geological and ecological gradients across the region

~ Day 1: Identifying Gaps & Needs~

12:30-12:45	**Check In**

12:45 – 13:15	**1. Welcome, Overview of Meeting Objectives, and Introductions** Objective: Welcome everyone, review agenda and objectives. Gather additional thoughts from attendees about objectives.
13:15-14:15	**2. State of the Science** Objective: Share the state of the science and monitoring in a *brief* review of the 2016 January Workshop. Explore key findings related to chemistry, modeling and organismal response. Guided discussion.
14:15-15:00	**3. Stakeholder Needs** Objective: Discussion of stakeholder needs and how this overlaps with scientific needs. Taking off the scientist cap- Who's driving the effort?
15:15-15:45	**4. Review of current assets** Objective: Review the map of *current* assets and add additional *current assets* as needed
15:45-16:45	**5. Gradients** Objective: Review map of known physical, geological and ecological gradients in the Southeast and discuss additional gradients.
16:45-18:00	**6. Setting the stage for tomorrow** Objective: Guided discussion for identifying the criteria for an ideal monitoring location

~ Day 2: Logistics of New Monitoring ~

7:30 – 8:00	**Continental Breakfast in the Meeting Room**
8:00 – 8:15	**7. Review of Agenda Day 2** Objective: Welcome everyone and review agenda and objectives
8:15 – 8:45	**8. Overview from Day 1** Objective: Discuss the key findings from Day 1 and add any additional points

8:45 – 10:30	**9. Identifying Key Gaps in Monitoring: Breakout**
	Objective: Brainstorming for gaps in monitoring, considering key species, chemistry and stakeholders
	
	Activities/Interactions:
	• Introduce ideas for gaps in critical monitoring: what are prioritizing in terms of scientific understanding, species and stakeholders?
	• Breakout groups by expertise
	  o Chemistry and modeling
	  o Species response *and* stakeholder needs
	  o Management needs and coastal acidification
	• Breakout groups will decide on 3-5 propose monitoring locations

10:30 – 10:45	Coffee Break
10:45 – 12:15	**10. Identifying Key Gaps in Monitoring: Discussion** Objective: Discuss findings from breakouts and reach consensus of proposed monitoring locations by dot vote Activities/Interactions: • Each group will present their findings and propose their 3-5 chosen locations and proposed locations will be added to the map of current monitoring (30 mins) • All attendees will vote on their decisions for the top 3 choices (10 mins) and all locations will be ranked (10 mins) Guided discussion (70 mins)

13:00 – 14:15	**11. Logistics and Opportunities: Breakout** Objective: Brainstorm ideas for opportunities in monitoring Activities/Interactions: • Are there other people that should be involved in this process? • Introduce opportunities we know of and provide examples (e.g. creative volunteer programs) • Breakout groups will depend on priority locations chosen in the last breakout • Introduce objectives for breakout groups o Leveraging existing monitoring o Partnership opportunities o Funding opportunities
14:15 – 15:30	**12. Logistics and Opportunities: Discussion** Objective: Discuss findings from breakouts and identify opportunities to pursue. Prioritize logistically feasible approaches and identify key participants to move forward.
15:30 – 16:30	**13. Wrap up and Products** Objective: Present key findings over last 2 days and discuss products of the meeting and future avenues for pursuing monitoring. Outline recommendation report.

II. APPENDIX II: PARTICIPANT LIST

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