



Mid-Atlantic Coastal Acidification Network

5 YEAR COMPREHENSIVE WORK PLAN

(FISCAL YEAR 2024-2028)

Workgroup leads:

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Description:

MACAN is a virtual nexus of researchers, educators, resource managers, and industry partners whose mission is to understand and communicate the causes and effects of acidification. MACAN is one of six coastal acidification networks in the USA and is co-hosted through the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS). MACAN regularly collaborates with the other Coastal Acidification Networks (CANs) through workshops, outreach webinars, research proposals, peer-review paper writing, and other outreach activities. MACAN aims to synthesize the results of research conducted within the region, clearly communicate the state-of-the-science to stakeholders, and enhance OA literacy within our coastal communities.

MACAN was initially established in collaboration with NOAA's Ocean Acidification Program. The CANs are now mandated through the Federal Ocean Acidification Research and Monitoring (FORAM) act (2009 with reenactments through 2017) and more recently Coordinated Ocean Observations and Research Act of 2020. The CANs interact with NOAA as well as the Interagency Work Group on Ocean Acidification (IWG-OA) on a regular basis to inform national level reports and science communication activities. MACAN and its partners are also integral in the development of state-led OA action planning, mitigation, and restoration efforts.

1. Workshops/Meetings

MACAN will continue to hold in-person meetings as well as virtual workshops. In-person meetings will include state-of-the-science workshops on a biannual basis with virtual networking and meeting opportunities in

alternate years. Workshop topics and themes will focus on suggestions at previous meetings and other input from the MACAN Steering Committee. Deliverables for each workshop will at minimum include an Executive Summary and video of the meeting to be posted on the MACAN website or a meeting report with Executive Summary to be posted on the MACAN website. Additionally, an email communication will be sent to all MACAN members and those on the MACAN listserv with links to all meeting materials.

- **1.1 State Agency OA collaboration workshop** - (1 to 2 days, in-person) Spring or Fall 2024
 - In Q1 or Q3 of 2024, the OA Alliance has requested MACAN's partnership to bring together state agencies to collaborate on topics related to state-level OA action planning and coordination across the region for implementation and resource management. Similar to the OA Alliances West Coast Acidification and Hypoxia Symposium, the purpose of this meeting is to explore common opportunities and challenges related to: (1) measuring and communicating impact; (2) designing synthesis and visualization products that support existing management priorities; (3) developing indicators; (4) evaluating water quality impacts; (5) exploring the role of coastal wetlands/submerged vegetation; (6) policy and decision making.
 - This workshop will be in-person, if funded by the OA Alliance (covering meeting space, AV, and other in-person expenses except travel), and will be organized by MACAN and the OA Alliance. If the OA Alliance is not able to provide funding, MACAN will host it as a virtual workshop. All of the Mid-Atlantic States will be invited to participate in presentations and breakout discussion sessions.
 - Partners: OA Alliance, NY/NJ/DE/MD/VA state agencies
 - Funding is requested for travel assistance for attendees from OAP Funds
- **1.2 State of Science workshop** - (2 days) Fall 2025
 - Topics and themes to be determined in consultation with the Steering Committee closer to the event. This meeting will also be used to help launch more coordinated MARCO marine carbon dioxide removal efforts.
 - Funding for travel/speakers/reception/location
- **1.3 Tribal and/or Under-represented Engagement Listening Session/Workshop** (1 day) 2026
 - MACAN will coordinate with MARCO's tribal consulting contractor to develop a timeline and scope for engaging with tribes, which could include:
 - Partnering with SOCAN (Southeast Ocean and Coastal Acidification Network) to host a one-day, in-person tribal listening session either in Virginia or eastern North Carolina. If in-person is not possible, then the event will be held virtually. For in-person, MACAN will use funds from the OAP core funding to provide a meeting space. MACAN will partner with either the NERRs or NEP to find the space.
 - In year 1, MACAN will leverage the contracted MARCO tribal consultant to make contacts; host virtual listening sessions, then follow with workshop in Year 2

- Invitees will include Shinnecock, Gullah/Geechee, and other regional tribal representatives from both the southeast and northeast

Potential Questions for listening session:

- Barriers? Funding (grant-writing)? Expertise?
- Workforce development needs
- Technological assistance needs (monitoring?)
- Reflections on how MACAN can assist
- NERR facility donation - CBNERR or APNERR (Virginia or North Carolina)
- Funding for space, tribal travel/speakers & MACAN Staff OAP
- **1.4 State of Science workshop-** (2 days) Fall 2027
 - Topics and themes to be determined in consultation with the Steering Committee closer to the event.
 - Funding for travel/speakers/reception/location-
- **1.5 ½ Day Virtual Workshop** (Fall 2028) - Staff time
 - No MARCO funding requested.

Potential Metrics for this task:

- *Attendance*
- *Attendance by new (never attended a MACAN workshop) partners*
- *New themes*
- *Workshop evaluation tool*
- *Deliverables (papers, reports, videos of recorded meetings)*

2. **Webinar Series (2-5 webinars per year for five years)**

MACAN will continue to host an annual webinar series. Each year's topics will be based on expressed interest by MACAN participants. MACAN will poll the membership at meetings as well as add topics that are timely.

- Year 1 Topics (no specific order; subsequent year's topics based on input from virtual and in-person workshops):
 - MACAN priorities/Current Projects
 - mCDR overview of regional funded projects (this overlaps with Carbon Solutions Workgroup - could include kickoff of new workgroup)
 - Information on monitoring limitations/effectiveness w/in our region
 - How Maryland is tying together OA/mCDR efforts, specifically blue carbon
 - Hotspots project updates
 - Monitoring Inventory project data products (could overlap with a Portal How Tuesday webinar)

Potential Metrics for this task:

- *Number of attendees (Goal - 40 per webinar)*
- *Views on youtube*

3. Marine Carbon Dioxide Removal

mCDR is a new area of research and development that has been funded by NOAA's Ocean Acidification Program (OAP). In 2023, seven projects on various aspects of, and methodology for mCDR were funded in the Mid-Atlantic region. MACAN will support the mCDR effort by helping to launch a new MARCO workgroup focused on the technologies used to implement mCDR, nature based solutions to mCDR, and how blue carbon plays a role in reducing the impacts of climate change and acidification (discussed in more detail below).

mCDR

- Compile a list of funded research projects and industry initiatives in the Mid-Atlantic for internal tracking and for sharing on the MACAN website, including, but not limited to:
 - [Mid-A projects](#) (those projects that have PI's in the Mid-A and/or with study sites/labs) - **SEVEN**
 - Assessing the laboratory and field responses of diatoms and coccolithophores to ocean alkalinity enhancement - *PI's at Rutgers*
 - Assessing efficacy of electrochemical ocean alkalinity enhancement at an existing outfall using tracer release experiments and oceanographic models - *PI at American University*
 - Developing a coupled benthic-pelagic biogeochemical model to evaluate the effectiveness of mCDR interventions - *PI's at Rutgers and UMCES*
 - Determining the Influence of Ocean Alkalinity Enhancement on Foraminifera Calcification, Distribution, and CaCO₃ Production - *PI at Vassar*
 - [Coupling Desalination with Novel mCDR Membranes](#) - *PI at University of Pittsburgh*
 - Data requirements for quantifying natural variability and the background ocean carbon sink in mCDR models - *PI at Columbia University*
 - Quantifying the Efficacy of Wastewater Alkalinity Enhancement on mCDR and Acidification Mitigation in a Large Estuary - *PI's at UMCES and University of Delaware*
 - Invite industry partners to update the steering committee on research and development efforts within the Mid-Atlantic
 - MACAN leads from both MARCO and MARACOOS will have a seat on MARCO workgroup for mCDR, blue carbon, and nature-based solutions

- Invite state partners, researchers, and industry representatives to a networking/virtual happy hour to discuss mCDR advances (Year 1 - align with MARCO Carbon Solutions workgroup kickoff)
- Synthesize data needs by reaching out directly to stakeholders and state agencies to determine that they want to be monitored with respect to new mCDR projects in the region. This objective was suggested at the MACAN SOTS 2023 meeting by an industry representative. In light of this request, MACAN will incorporate the need into the review of the ongoing projects and based on previous coastal acidification research and data needs.
- At the MACAN 2025 meeting, there will be a full session devoted to the regional mCDR efforts, which will feature the kickoff of the MARCO workgroup that will focus on mCDR, blue carbon, and nature based solutions to carbon-driven climate change issues.
- MACAN will maintain a close relationship with the MARCO workgroup mentioned above but will not lead MARCO's mCDR or blue carbon efforts. MACAN will continue to participate in communications and collaborations with OAP for mCDR related activities as needed.

Potential Metrics for this task:

- *Number of attendees to virtual and in-person meetings*
- *Number of updates from industry partners to MACAN*
- *Number of clicks/engagement on MACAN website page about mCDR projects in the region*

4. Fellowship and travel stipends (Years 1 - 5)

MACAN will continue to provide workforce development fellowships to college students on a yearly basis. Fellowships provide an opportunity to support under-represented students in developing hands-on experience and knowledge about OA science, policy, and communications. MACAN has access to various subject matter experts and partnerships that can enhance career development. Each year, up to \$70,000 in funding will be available to support up to two fellowship awards. The themes/topics will be largely outlined by the students, however, in some years there will be prescribed topics based on needs expressed to MACAN by partner organizations/researchers. Each project will have at least one deliverable defined in the student's scope of work. Deliverables could include, but are not limited to, peer-review papers, posters at meetings, digital media, other printed materials, and data layers for the Mid-Atlantic Data Portal and/or MARACOOS' Oceans Map. Travel to scientific or educator conferences and other relevant meetings will support student's professional development and enhance networking opportunities for future career development. The Fellowship timeline will align as closely as possible with the academic year (August through June, possibly extending over the summer if the student is registered for summer classes or internships), with publication of the request for funding proposals (RFP) in the first quarter of the calendar year. Funding for the student would be expected to start in the third quarter of the calendar year.

4.1 Fellowship for Fall 2024 - Summer 2025 (Education/outreach theme)

- Partnering with the Chesapeake Bay VA National Estuarine Research Reserve, MACAN will expand on the Coastal Acidification Curriculum provided through the Teachers On The Estuary (TOTES) workshops in 2021-2023. The student will be mentored by staff from the CBNERR to align the Coastal Acidification Curriculum with NGSS standards, so that this curriculum can be expanded beyond Virginia. Funding will include travel support to present at the Mid-Atlantic Marine Educators Association Meeting. Using economically important species from the Mid-A, lessons/classroom activities on the biological effects of acidification will be developed. Pilot lesson plans can be trialed at CBNERR-VA TOTE workshop in summer of 2025. All deliverable lesson plans will be accessible on the MACAN website. In subsequent years, this program will be expanded and tailored to include the NERRs in the other Mid-Atlantic states as well.

4.2 Fellowship for Fall 2025 - Summer 2026 - (Social Science) – topic TBD, the Fellow’s project will be aligned with MACAN steering committee priorities closer to the start date.

4.3 Fellowship for Fall 2026 - Summer 2027 - (Science) – topic TBD, the Fellow’s project will be aligned with MACAN steering committee priorities closer to the start date.

4.4 Fellowship for Fall 2027 - Summer 2028 - (Communication/Education)– topic TBD, the Fellow’s project will be aligned with MACAN steering committee priorities closer to the start date.

4.5 Fellowship for Fall 2028 - Summer 2029 - (Science)– topic TBD, the Fellow’s project will be aligned with MACAN steering committee priorities closer to the start date.

Potential Metrics for this task:

- *Number of fellowship applications received*
- *Number of deliverables generated from each project*

5. Other Education-Related Initiatives (Years 1-5)

MACAN has been invited to participate with the CBNERR VA and The Nature Conservancy Shellfish Growers Climate Coalition on a pilot partnership project- *Pending approval from external partners*. MACAN would use \$10K from the OAP core funding (see budget justification for the sub-award) for staff time to coordinate the project.

- Partner with The Nature Conservancy’s (TNC) Shellfish Climate Growers Coalition and VIMS Educators at the CBNERR-VA to train teachers in our areas (southeastern VA) about coastal acidification and impacts to shellfish and to help teachers set up a field experience for their students,

visiting a local shellfish grower to make connections to acidification, aquaculture, and workforce development.

- VIMS Educators and MACAN leads provide 1-day In-person training for Middle School and High School teachers from various school districts (to be determined by which teachers express interest)
- TNC to identify Local Shellfish Growers interested in providing an on-site field experience for middle school and high school students
- VIMS Educators assist teachers in planning field trips for students to local shellfish farms
- Evaluate Feasibility of expanding pilot to TNC's National Shellfish Growers Climate Coalition
- MACAN would work with TNC and CBNERR to scope/develop the project in year 1-2 and then implement the pilot project in year 2-3. In years 4-5, MACAN will work with the partners to scale the project to other states within the Mid-Atlantic.
- Present lessons learned, challenges, and successes at a regional scientific or outreach meeting in Year 4
- *Potential Metrics for this task*
 - *Number of students or school districts reached*
 - *Number of MS/HS teachers participating*
 - *Number of shellfish growers participating (particularly if the program expands regionally or nationally)*

6. STEAM project opportunity for youth (Years 3 - 5)

MACAN will scope and develop a Science, Technology, Engineering, Art, and Math competition geared towards middle school aged youth. Many Sea Grant sponsored annual outreach days, such as Delaware Coast Day, feature competitions to engage younger students in ocean literacy and climate solutions. The competitions often allow the students to present their entry in-person at the event. MACAN will provide a small award (to be determined based on federal guidelines) to the student entries. In year 3 the competition will be scoped and in years 4 and 5 MACAN will participate in the events where the competition will be featured.

- Tie in with University of Delaware's Coast Day/other State's Sea Grant outreach events or NY Climate Week events
 - Funding would be for staff time/travel, table at event and materials including competition award per year - two events per year from OAP Funding for work plan from FY27
- Potential competition ideas could include:
 - Design Challenge - build or draw some futuristic technology that can capture CO₂ from the air, or protect reefs/oysters/corals/seagrasses from acidification
 - Video Challenge - create a video about solutions to acidification
- All entries will be photographed and featured on the MACAN website
- Winners will be highlighted on website

Potential Metrics for this task:

- *Number of entries*
- *Number of website views*

7. New Outreach or Data products from Monitoring Inventory and Hotspots Analysis (Years 2 - 5) (Staff time & publication costs from OAP)

MACAN will develop new data products and tools based on results and outcomes of the different ongoing projects as the opportunities arise. All datasets will include a digital object identifier, metadata, and abstract. Some of the intended data layers could include, but are not limited to:

- New data layers from monitoring inventory on MARCO Ocean Data Portal and MARACOOS Oceans Map
 - Monitoring map overlaid with benthic habitats
 - Monitoring by season data layer on MARCO Ocean Data Portal
- Consider needs from Monitoring Priorities report, match with vulnerability report to create a list of location priorities (brief paper for journal aimed at natural resources management) - OAP funded (publication costs)
 - Deep sea corals/impacts from offshore wind
- Monitoring/Sensor Choice Decision Tree tool -
 - Based on the findings discussed in the Monitoring Inventory white paper, create a web user interface tool on MACAN's website to help decision makers, program managers, and water quality monitoring organizations find the information needed to build or expand their carbonate chemistry monitoring programs.
- Use data from Hotspots project to develop other lines of research, which could include but will not be limited to:
 - How do economically important fish/shellfish stocks respond to low pH or acidified waters?
 - Update dataset
 - Can in situ studies be used to complement acidification predictions derived from the dataset?

8. Additional Collaborations (Years 1 - 5)

MACAN will participate in collaborations with National Estuary Programs, National Estuarine Research Reserves, the Virginia Coastal Reserve Long-Term Ecological Research (VCR LTER), and other non-profit organizations as they arise. This activity supports research and monitoring opportunities in the region and will help grow the monitoring network.

- Collaborate with Barnegat Bay NEP (New Jersey) on pilot Pro-Oceanus $p\text{CO}_2$ validation project and provide data synthesis support.
 - This project can be scaled to other NEPs in the region as well as any partner that initiates a similar monitoring program. Not all partners that have carbonate parameter monitoring

capabilities have staff members that are familiar with carbonate chemistry and divers of acidification. Therefore, to help make their programs successful and thrive, MACAN can offer data synthesis support and knowledge transfer to help improve program outcomes and deliverables.

- Outcomes: knowledge transfer, advance monitoring and increase spatial coverage, collaborative proposal writing, overlap with fellowship goals and mentorship potential
- Potential metrics: number of collaborations and programs implemented

9. MACAN Website maintenance (Years 1 - 5)

General Updates and New materials to add

- mCDR page and link the current NOAA funded projects
- Include lesson plans and products from internship/fellowship projects

10. Social Media (Years 1 - 5)

- Capture metrics for facebook/instagram
 - Engagement goals
 - In 2022-2023, reached 870, content published 15; engagement 28, Net Followers 3
 - In 2024-2025 aim to reach 1500, content published 30, engagement 50, net followers 10