National Estuarine Research Reserve System Sentinel Site Program

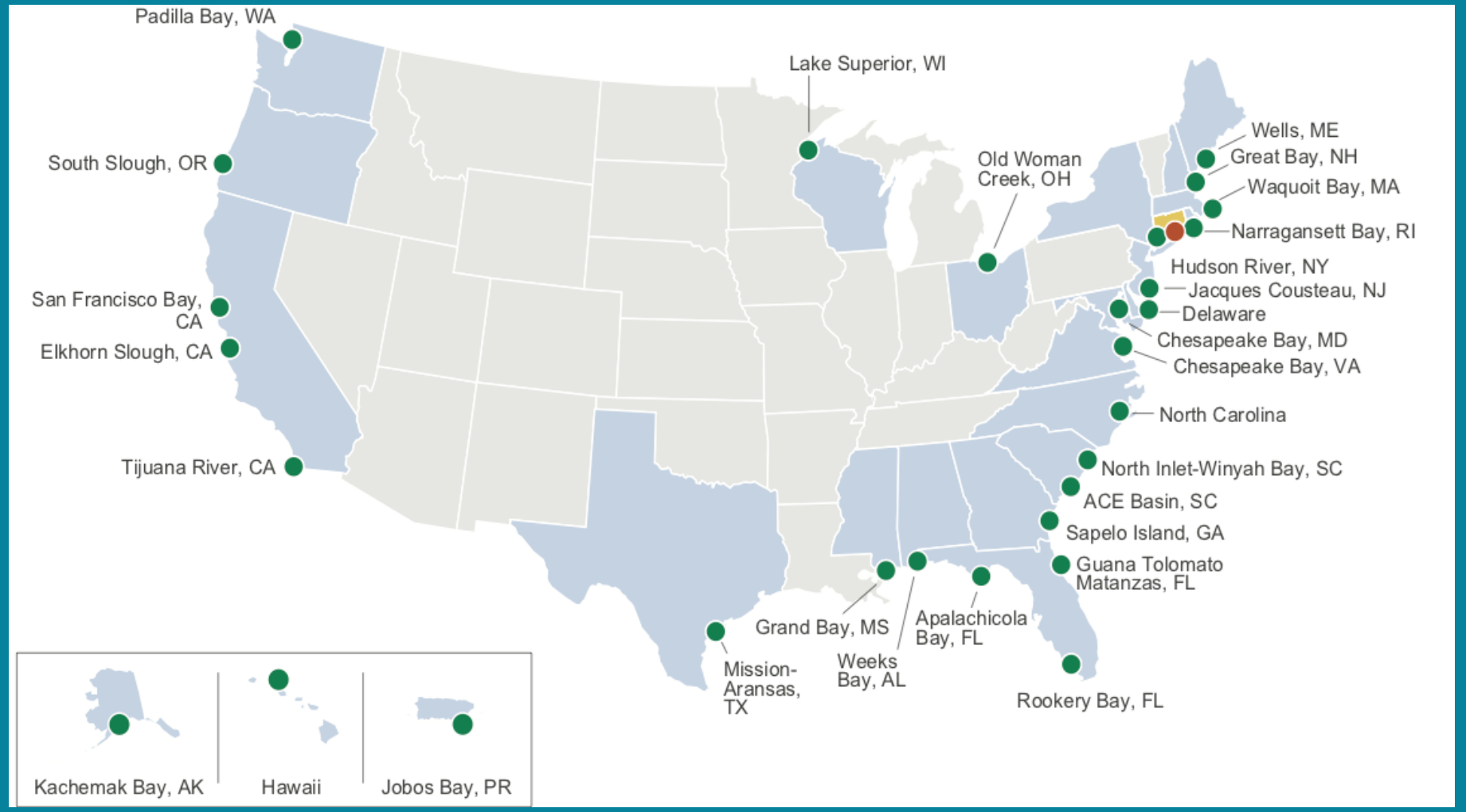
Shallow Water Habitat Sentinel Site Program
Development Workshop
9/17/2025

CHESAPEAKE BAY
NATIONAL ESTUARINE
RESEARCH RESERVE
VIRGINIA

VIMS | William & Mary
Virginia Institute of Marine Science

The NERRS

30 sites around the country



CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

NERR System-Wide Monitoring Program (SWMP)

- Established in 1995
- The application of key indicators of estuarine function using consistent vetted protocols.
- Designed to detect short term variation and long-term trends
- Includes abiotic, biotic and habitat elements
- Elements are either Core Funded, Core Optional, or Elective
- Provides long-term environmental monitoring data that can address management issues, rather than testing pre-determined hypothesis.

*Reserves are **sentinel sites** because SWMP data provides the capacity for early detection of environmental change.*

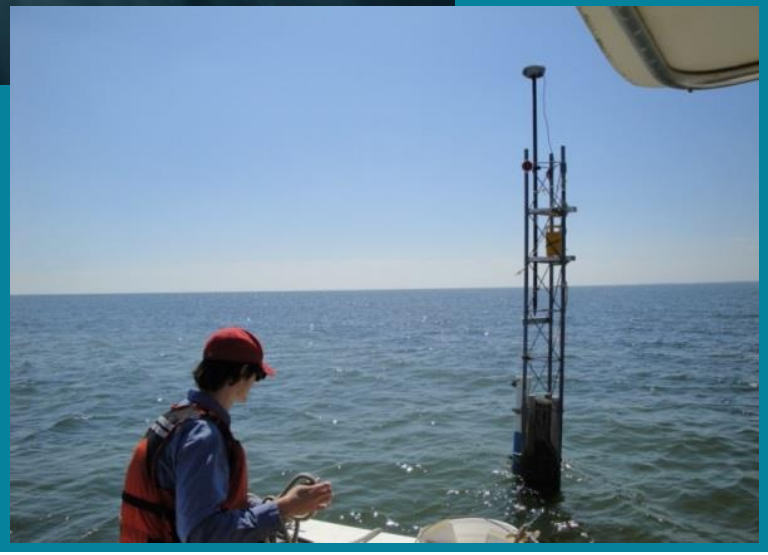
NERR System-Wide Monitoring Program (SWMP)

- Established in 1995
- The application of key indicators of estuarine function using consistent vetted protocols.
- Designed to detect short term variation and long-term trends
- Includes abiotic, biotic and habitat elements
- Elements are either Core Funded, Core Optional, or Elective
- Provides long-term environmental monitoring data that can address management issues, rather than testing pre-determined hypothesis.

*Reserves are **sentinel sites** because SWMP data provides the capacity for early detection of environmental change.*

YSI EXO II

- Temperature
- Chlorophyll
- Turbidity
- Salinity
- Specific Conductivity
- pH
- Dissolved Oxygen
- Depth



CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

- **CDMO and NERRS Data Management Committee have established 6 priority areas in support of SWMP:**

1. Provides access to data and metadata via online server

2. Provide technical support services to the NERRS

3. Conduct annual CDMO Data Management Committee meeting

4. Conduct annual Technician Training Workshop

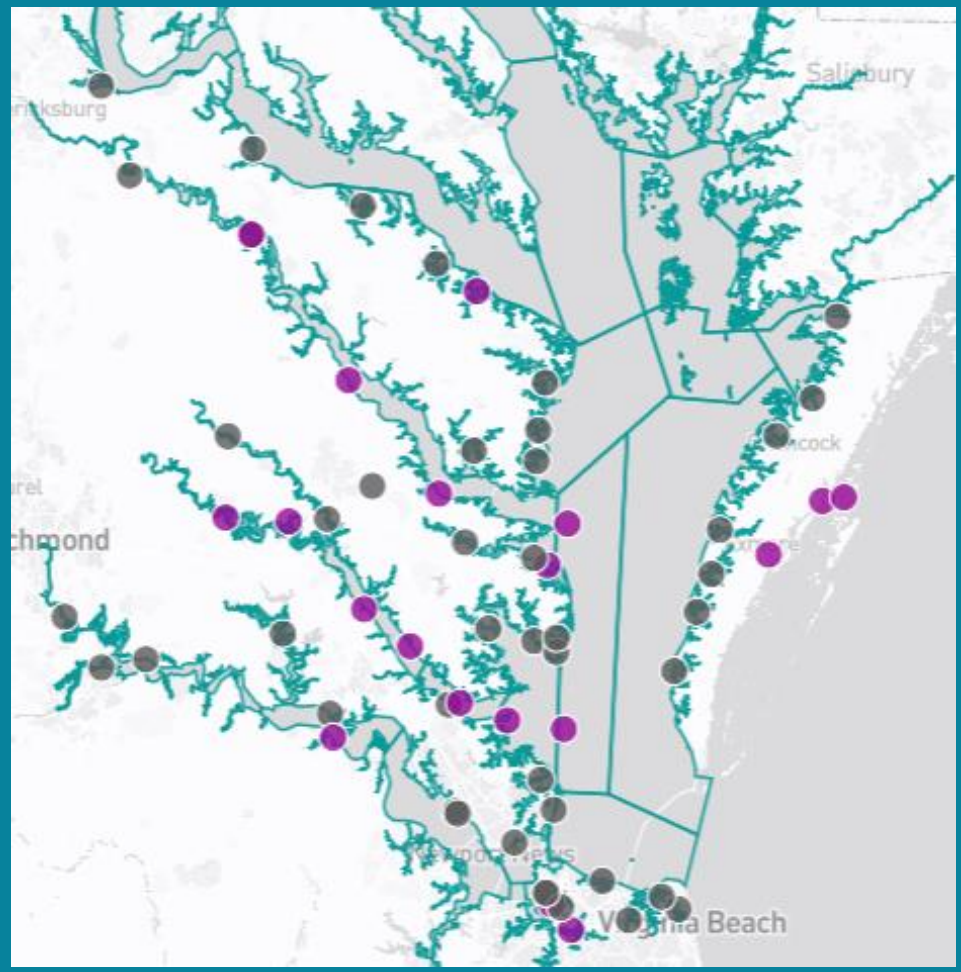
5. Provide technical consultation for special NOAA projects

6. Provide telemetry support for SWMP

CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

Chesapeake Bay National Estuarine Resarch Reserve Virginia



CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

CBNERR-VA Monitoring Platforms

Fixed Stations

Near Bottom *

Shallow water areas

15-min measurements

adaptable to meet user needs

Dataflow

Surface

2-3 sec measurements

25 knots -> sample ever 25m

CBIBS Buoy

Surface

Floating buoy

6-min measurements

CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY

VIRGINIA INSTITUTE OF MARINE SCIENCE

VIMS | William & Mary
Virginia Institute of Marine Science

Chesapeake Bay National Estuarine Research Reserve Virginia

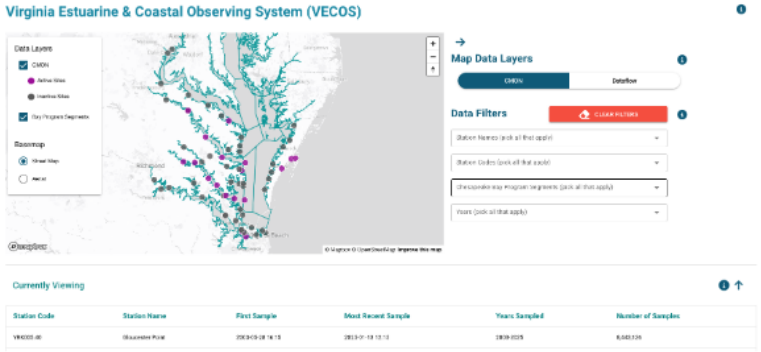
VECOS

Virginia Estuarine & Coastal Observing System (VECOS)

22 years of monitoring

211,856,664 water quality observations

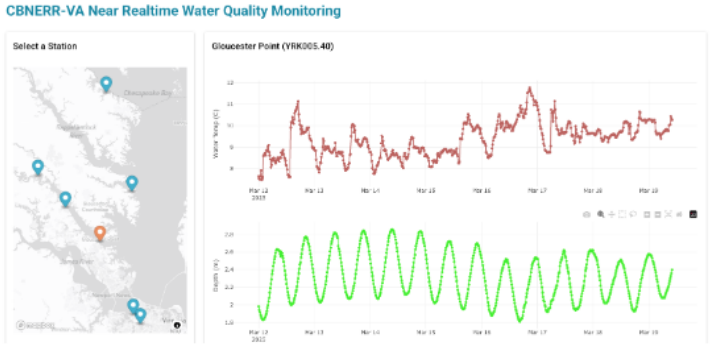
Data Dashboard



The data dashboard provides access and visualization for all quality controlled data.

GO TO DATA DASHBOARD

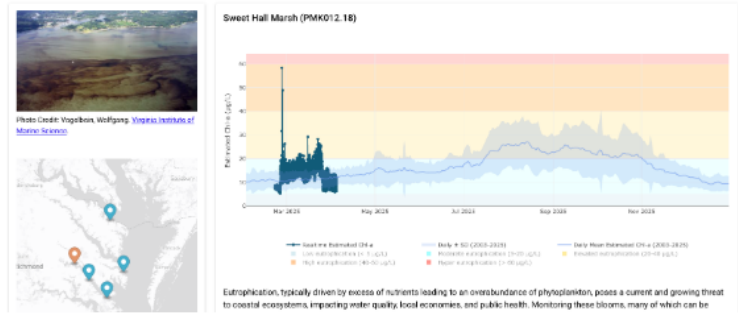
Realtime Dashboard



The realtime data dashboard provides access and visualization of recent observations collected from our fixed stations equipped with telemetry.

GO TO REALTIME DASHBOARD

Data Applications



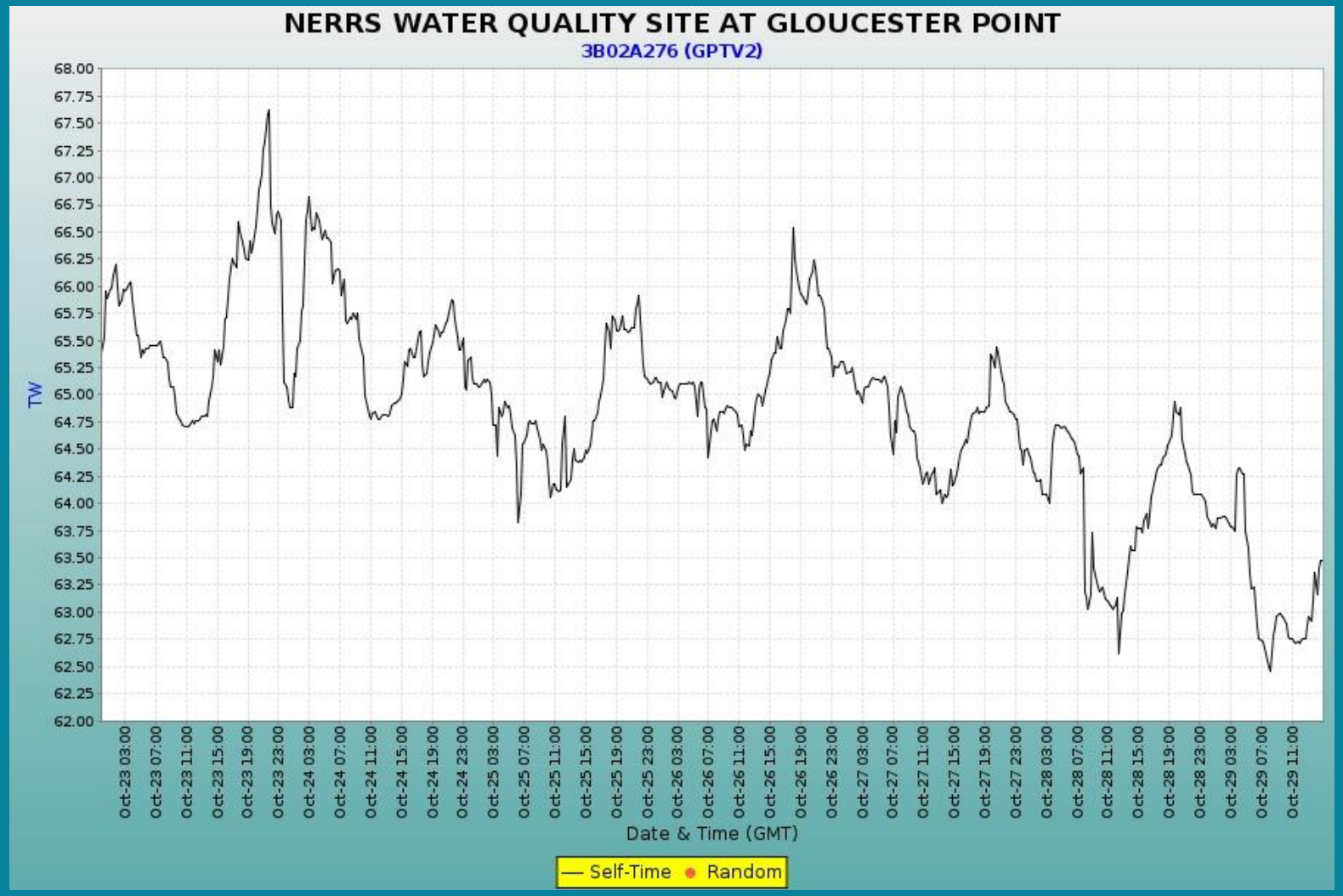
Our Data Applications provide environmental insights leaveraging our near-realtime monitoring data.

GO TO DATA APPLICATIONS

vecos.vims.edu

Telemetry and Station Monitoring Quality Assurance

Data telemetered via satellite in near-realtime

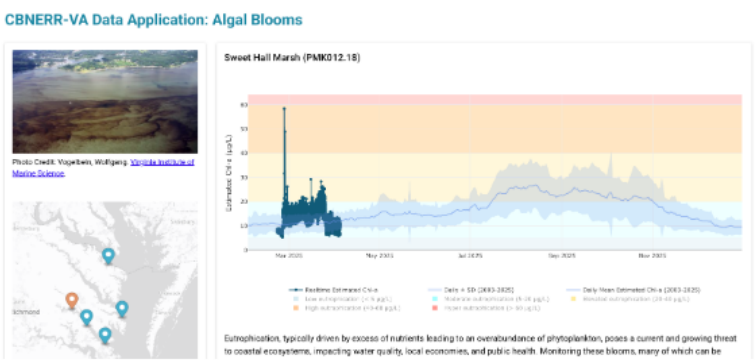


NOAA Hydrometeorological Automated Data System (HADS)

VECOS Data Applications

https://vecos.vims.edu/data_applications

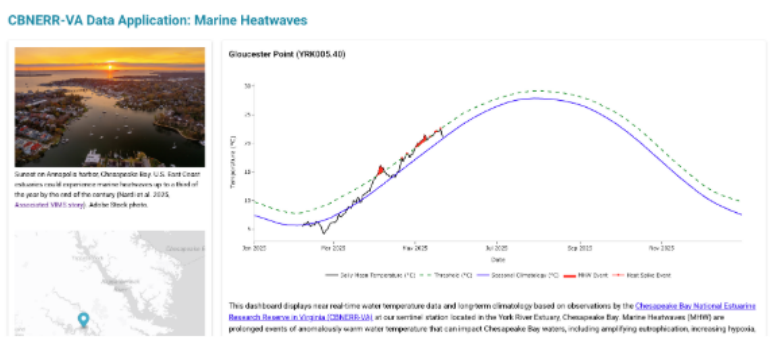
Algal Blooms



The Algal Blooms Data Application provides access to the latest data on Algal Bloom events.

GO TO ALGAL BLOOM DATA APPLICATION

Marine Heat Waves



The Marine Heat Waves Data Application provides access to the latest data on Marine Heat Wave events.

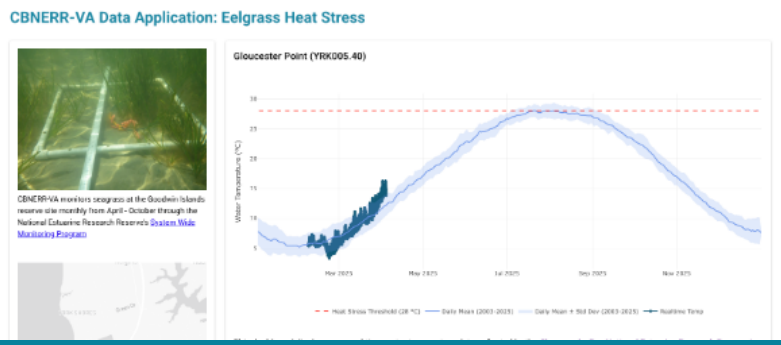
GO TO MARINE HEAT WAVES DATA APPLICATION

Acuff Center for Aquaculture Operations

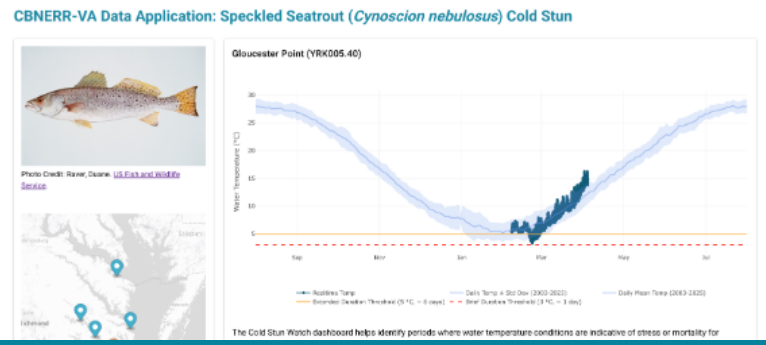
This application provides recent information on aquaculture operations at the Acuff Center.

GO TO ACUFF CENTER FOR AQUACULTURE OPERATIONS DATA APPLICATION

Eelgrass Heat Stress



Speckled Trout Cold Stun

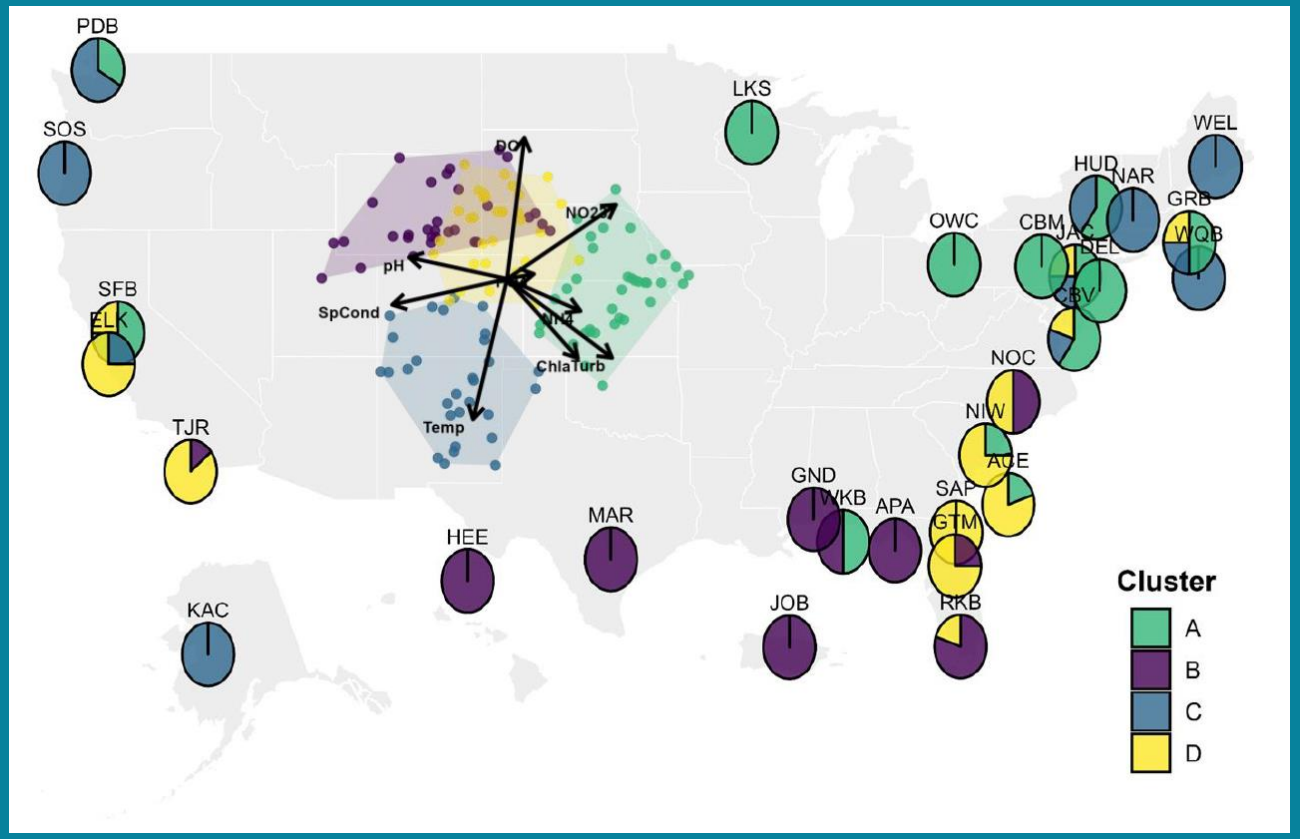


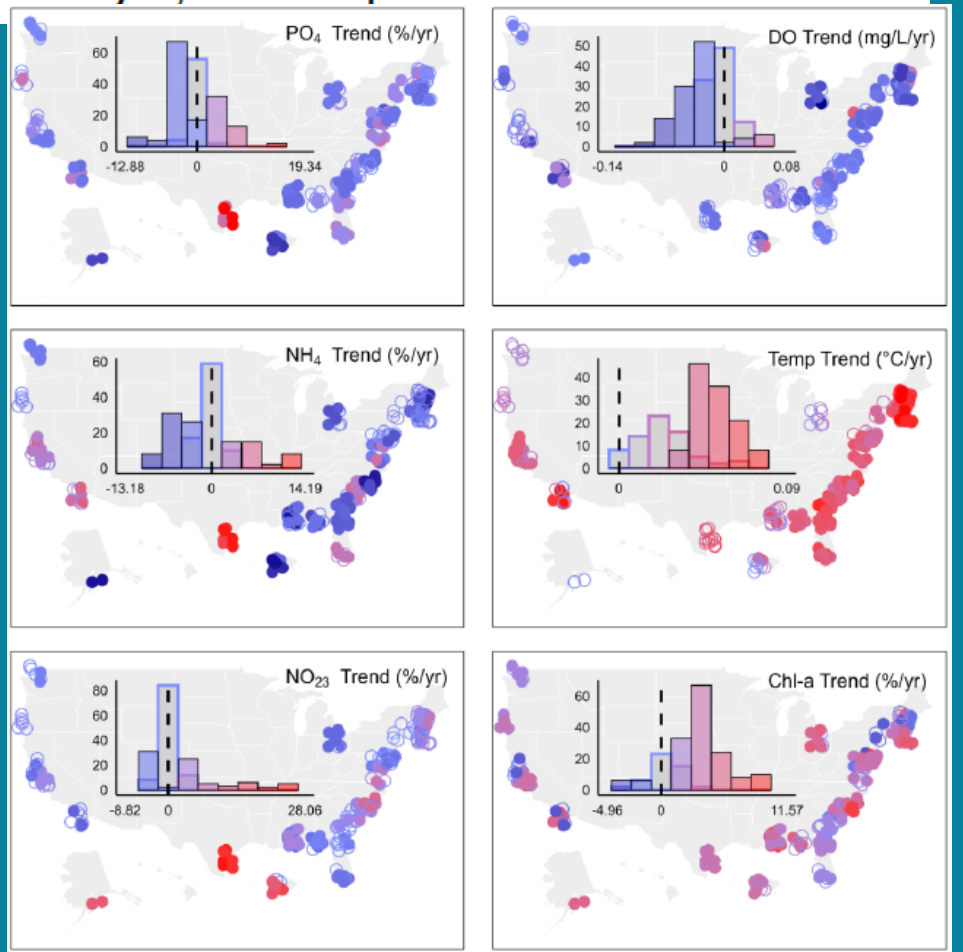
Data Use

- Virginia water quality standards assessment
  - Water clarity
- Potential for anchoring satellite and drone image datasets with in situ observations
  - Light conditions (turbidity, light attenuation)
  - Algal bloom (chlorophyll, chlorophyll-a, cell counts)
- Publicly available datasets
  - Research products
  - Education and outreach
- Advisory service

In Situ Observations Reveal Continental-Scale Warming, Oxygen Decline, and Eutrophication in U.S. Estuaries

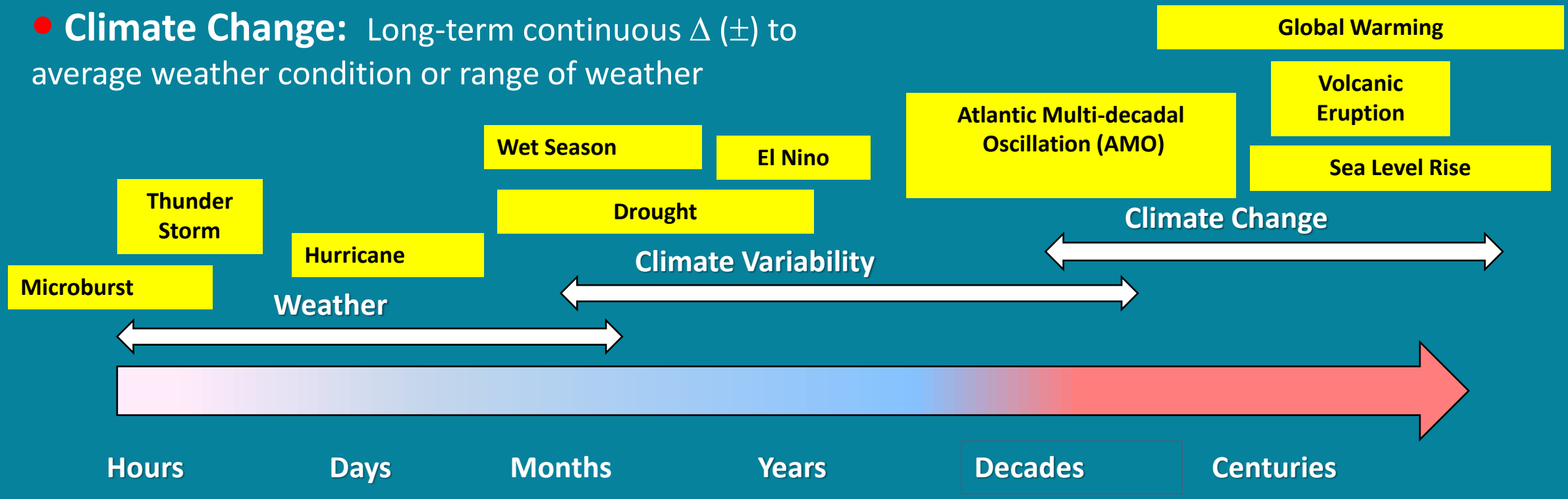
Kaitlin L. Reinl[1*], Robert P. Dunn[2,16], Kimberly A. Cressman[3], Theophilos Collins[4], Jennifer L. DeBose[5,6], Carl T. Friedrichs[7], Alicia R. Helms[8], Christopher Kinkade[9], Julie L. Krask[2], David B. Parrish[7], Hannah N. Nicklay[1], Justin T. Ridge[10], Denise M. Sanger[11], Jacob A. Cianci-Gaskill[12], Nicole G. Dix[13], Thomas M. Grothues[14], Steven E. McMurray[12], Christopher Peter[15]





Weather & Climate Scales

- **Weather:** State of atmosphere-ocean-land conditions over short periods of time (minutes to weeks)
- **Climate:** Weather patterns averaged longer periods of time, often averaged over 30 years (climatological 'normal')
- **Climate Variability:** Yearly climate fluctuations ± from long-term average
- **Climate Change:** Long-term continuous Δ (±) to average weather condition or range of weather



National Estuarine Research Reserve System (NERRS)
System-Wide Monitoring Program (SWMP)

Vegetation Monitoring Standard Operating Procedure
Long-term Monitoring of Estuarine Vegetation Communities

Version 1.2

March 2023

Adapted from:
Moore, K.A. 2013. NERRS SWMP Vegetation Monitoring Protocol, Long-term Monitoring of Estuarine Vegetation Communities. National Estuarine Research Reserve System Technical Report, Gloucester Point, VA. 36pp.

Written by:
NERR Biomonitoring Workgroup

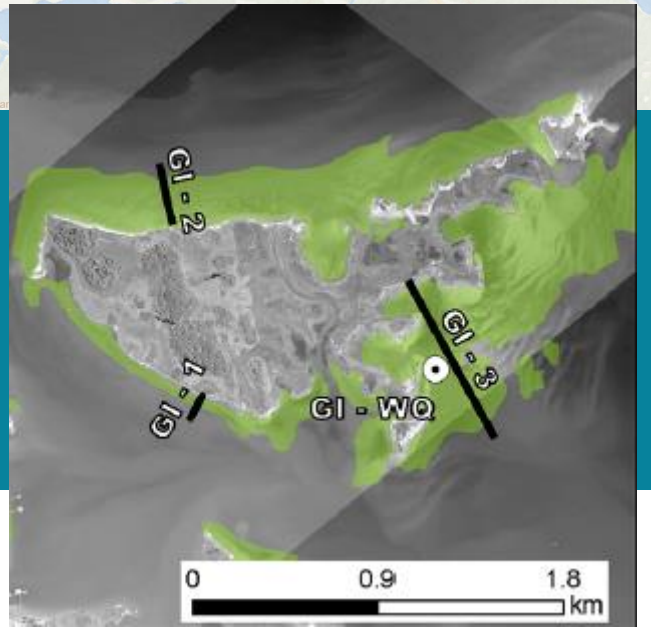
Edited by:
Kenneth Moore, Chesapeake Bay Virginia National Estuarine Research Reserve
Kerstin Wasson, Elkhorn Slough National Estuarine Research Reserve
Scott Lerberg, Chesapeake Bay Virginia National Estuarine Research Reserve
Melissa Ide, NERRS Centralized Data Management Office
Tracy Buck, NERRS Centralized Data Management Office

Vegetation Monitoring Protocol Objectives

- Quantify vegetation patterns and their change over space and time
- Maintain consistency with other monitoring protocols used nationally and worldwide
- Apply over a wide range of estuarine sites and habitats, and for a variety of reserve specific purposes
- Quantify relationships among the various edaphic factors and the processes that are regulating the patterns of distribution and abundance in these communities
- Support comprehensive remotely sensed mapping of vegetation communities and other NERRS SWMP data collection protocols, as well as NERRS/NOAA education, stewardship and restoration efforts

Methods

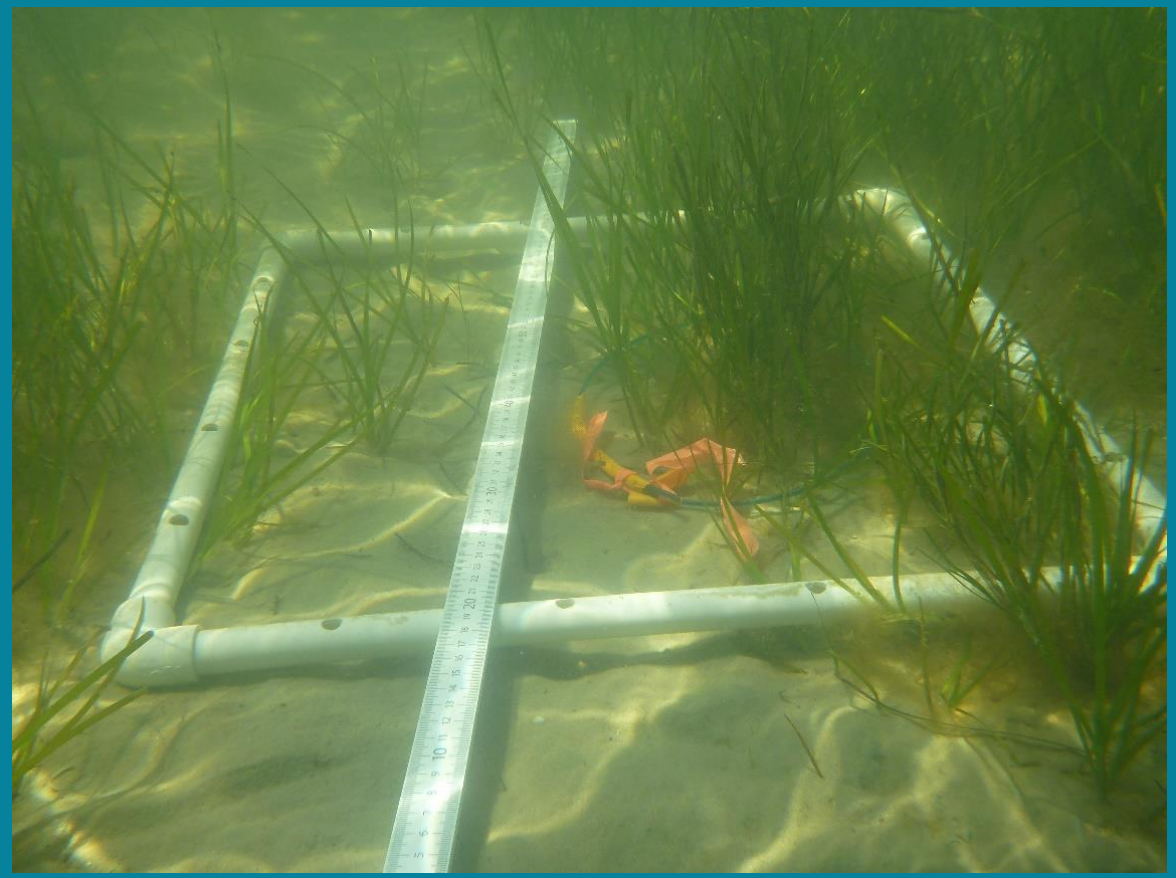
- Fixed transects with permanent sampling plots located along transects
- Site selection – Should be representative of existing estuarine vegetation communities in the region
- As much as possible, sites should be located alongside other SWMP monitoring



CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

SAV Methods



- At least annually during peak biomass
- Non-destructive sampling
- Percent cover by species
- Shoot density counts
- Maximum canopy height
- Water depth measurements

Vol. 448: 247–258, 2012
doi: 10.3354/meps09578

MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

Published February 23

Contribution to the Theme Section: 'Eelgrass recovery'

OPEN ACCESS

Eelgrass survival in two contrasting systems: role of turbidity and summer water temperatures

Kenneth A. Moore*, Erin C. Shields, David B. Parrish, Robert J. Orth

diversity

MDPI

Article

Adaptations by *Zostera marina* Dominated Seagrass Meadows in Response to Water Quality and Climate Forcing

Erin C. Shields *, Kenneth A. Moore and David B. Parrish

Estuaries and Coasts (2019) 42:755–764
https://doi.org/10.1007/s12237-019-00517-1

Short-Term Temperature Stress Results in Seagrass Community Shift in a Temperate Estuary

Erin C. Shields [1] · Dave Parrish [1] · Kenneth Moore [1]

Project Type:

Collaborative Research

Focus Areas:

Climate Change, Habitat Restoration

Keywords:

restoration, eelgrass, climate change

Lead Reserve:

Chesapeake Bay, VA

Reserves:

Chesapeake Bay, VA

Project Duration:

October 2022 - March 2025

Grant Amount:

$395,503.00

Project Lead:

Jessie Jarvis, University of North Carolina Wilmington, jarvisj@uncw.edu

Technical Lead:

Erin Shields, Chesapeake Bay NERR Virginia, eshields@vims.edu

Evaluating and Enhancing Eelgrass Resiliency and Restoration Potential in a Changing Climate

A network of the intended users from reserves, state agencies, and Chesapeake Bay nonprofits developed a framework to guide eelgrass restoration efforts with an emphasis on climate resilience.

In the lower Chesapeake Bay, Virginia, warmer water temperatures in recent years have resulted in large scale diebacks of eelgrass meadows (Zostera marina). Historically stable, dense eelgrass meadows have converted to low-density, ephemeral meadows. In contrast, many eelgrass populations in Back Sound, North Carolina appear to be more resilient to warming water temperatures. Restoring this iconic species in Virginia and beyond will require understanding the drivers of eelgrass resilience to climate change.

By coordinating a network of the intended users from reserves, state agencies, and Chesapeake Bay nonprofits, this project compared resiliency traits of eelgrass populations in Virginia and North Carolina. The project team worked with a user advisory group, which held regular brainstorming meetings, to design an approach that would inform management decisions related to eelgrass, especially restoration. The team conducted reciprocal restoration trials of Virginia and North Carolina eelgrass seeds (i.e. planting seeds sourced from NC at restoration sites in VA, and vice versa).

https://nerrssciencecollaborative.org/project/Jarvis22

NERRS Sentinel Site Application Module

- A collection of SWMP elements from various toolkits that have been packaged together to address a particular management issue at local, regional, or national scales
- Application Modules provide the means of addressing a research question in a manner that can be repeated or compared in a consistent manner across the system, now and in the future

Wetlands and Water Levels: Understanding vegetation resilience in the face of changing water levels

2020 survey of NERRS demonstrates importance of SAV monitoring for the Reserve System:

31 responses representing 27 reserves*:

- SAV grows in most, but not all reserves (14 of 27)

Approx half of reserves conduct SAV monitoring:

- Supported or partnered (10 reserves)
- Unfunded, opportunistic (3 reserves)

A third of reserves don't monitor SAV but would like to.

CHESAPEAKE BAY NATIONAL ESTUARINE RESEARCH RESERVE VIRGINIA

VIMS | WILLIAM & MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE

Reserves use a variety of monitoring methods for SAV:

- SeagrassNet or NERRS Biomonitoring protocols (9 reserves)
- Aerial imagery (4 reserves)
- Other methods using transects or quadrats (6 reserves)

Where does the SAV data go?

- Stays in-house and shared from reserve
- 3 reserves submit data to CDMO
- 2 reserves submit data to SeagrassNet

VIMS | William & Mary
Virginia Institute of Marine Science

NERRS Science Collaborative Catalyst Grant

Proposal: "SAVe the Data: Harmonization of NERRS Long-term SAV Monitoring Data to Inform Protocol and National Synthesis Development"

- Compilation and harmonization of existing SAV data: Establish consistent formats with support from CDMO to convert diverse SAV data to facilitate inter-reserve comparisons
- Pilot analyses to inform protocol development: Conduct a preliminary analysis of robust, harmonized SAV data to identify "lowest common denominator" and test potential methodologies for system-wide application
- Inform development of a tiered monitoring protocol framework: Outline a flexible, tiered protocol that can adapt to different reserve needs
- Capacity building and future roadmap: Establish advisory committee, ensuring ongoing support for protocol updates, governance, and data quality
- Create a roadmap for subsequent funding and research

Challenges We Faced Along the Way…

- FUNDING
  - Time Efficiency
  - Losing motivation
  - No core funding to submit data to CDMO
- Not every reserve has SAV
- Nation–wide: Diversity of habitats requires a lot of flexibility in protocols
- Data Ethics

Thank You!

Erin Shields
eshields@vims.edu