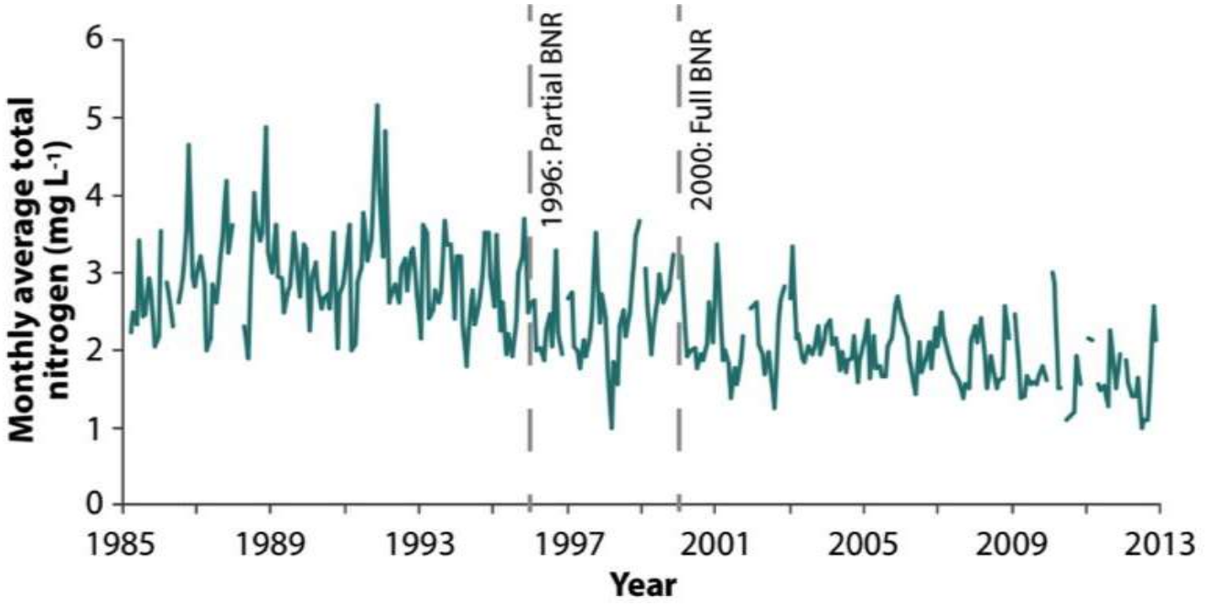
Key partnership success associated with ecosystem improvements & addressing gaps in our outcome attainability

Bill Dennison

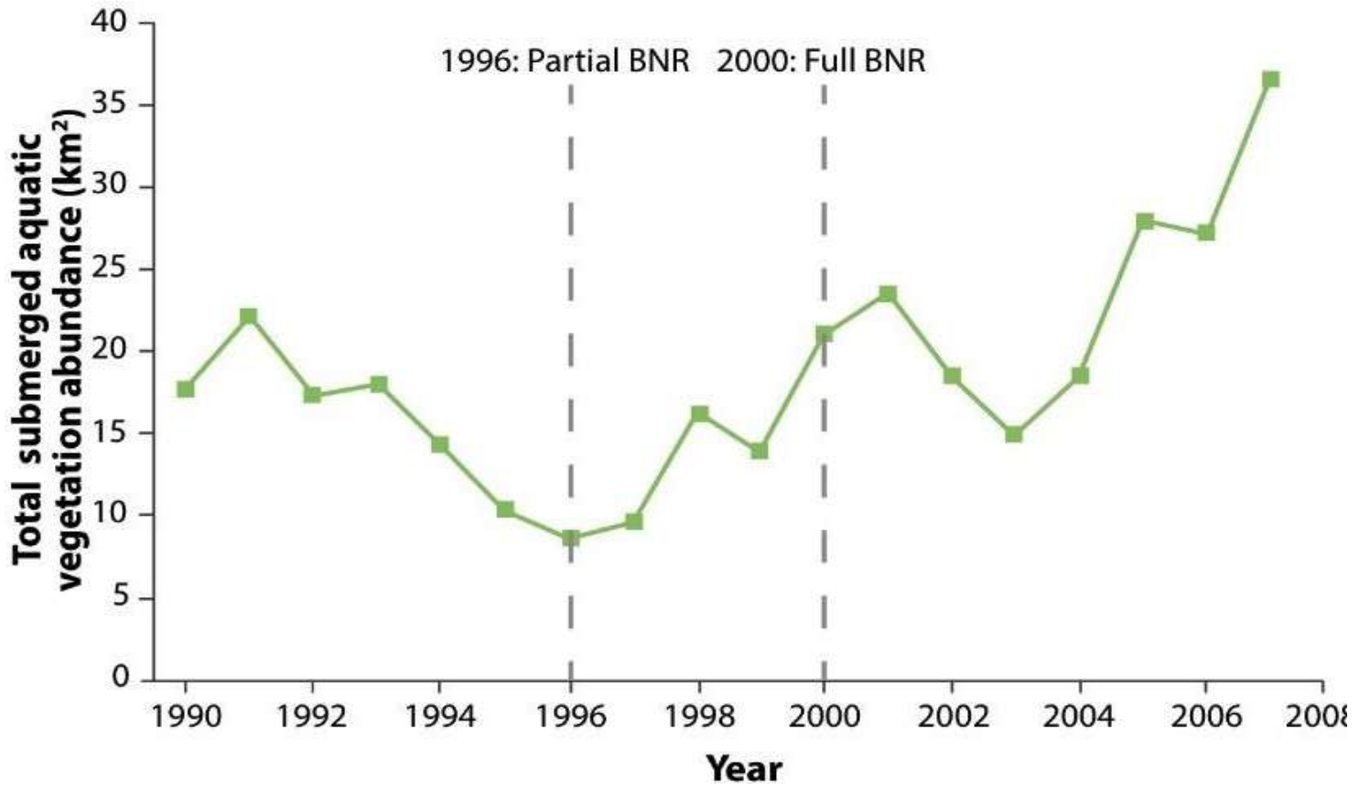
Strategy Review System
11 May 2023
Charlottesville, VA

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

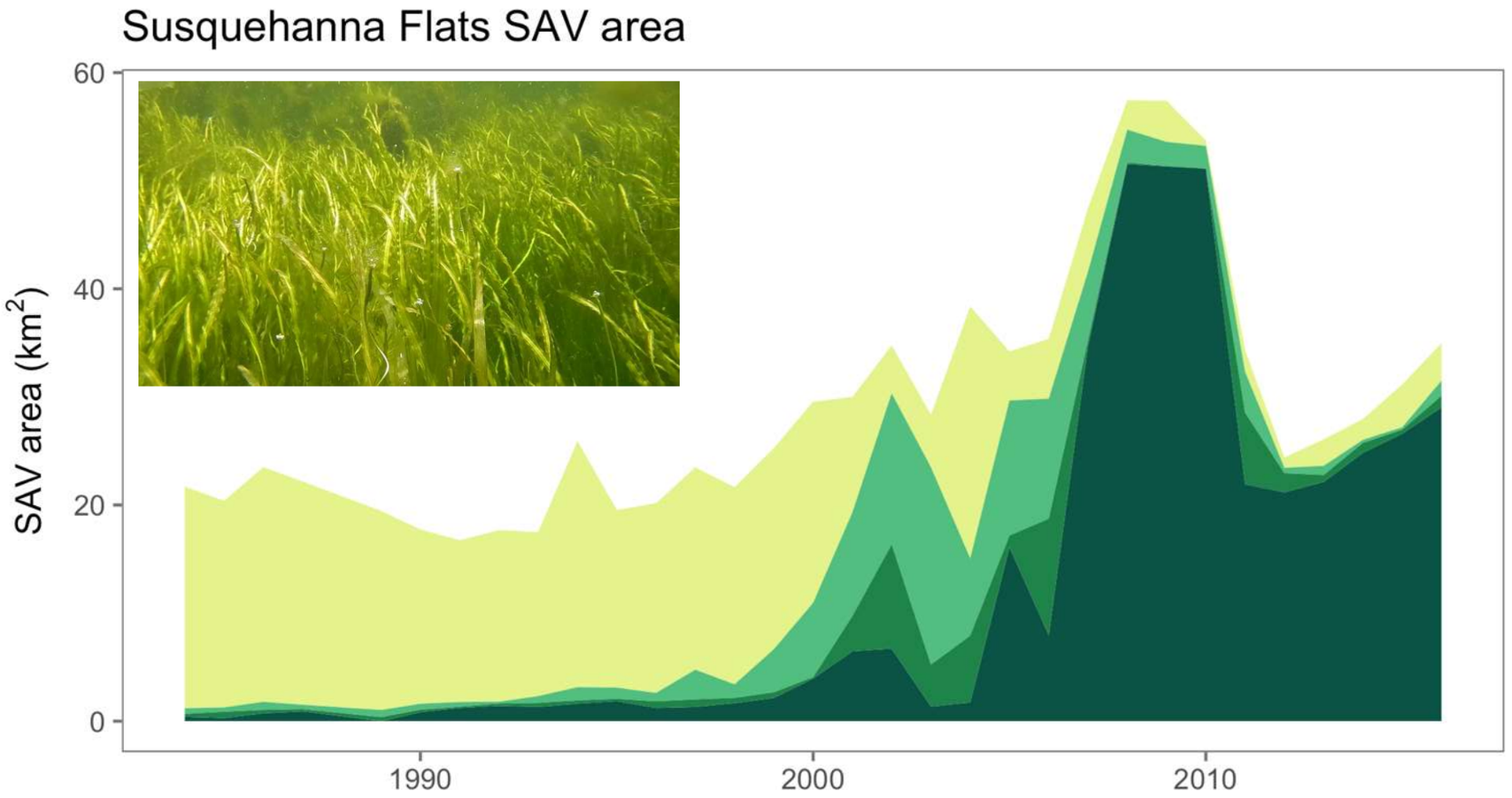
Sewage upgrades have resulted in significant reductions in nutrient loads attainability

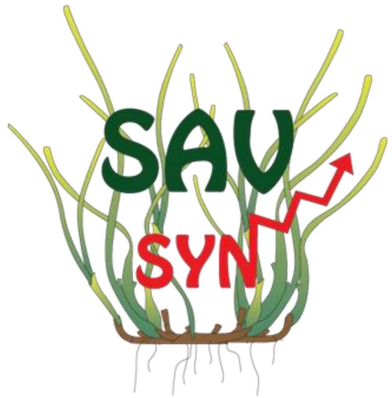


Sewage upgrades have led to SAV resurgence



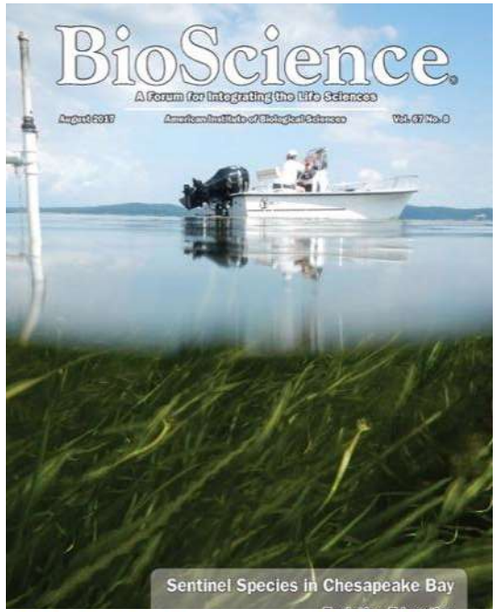
SAV recovery is resilient





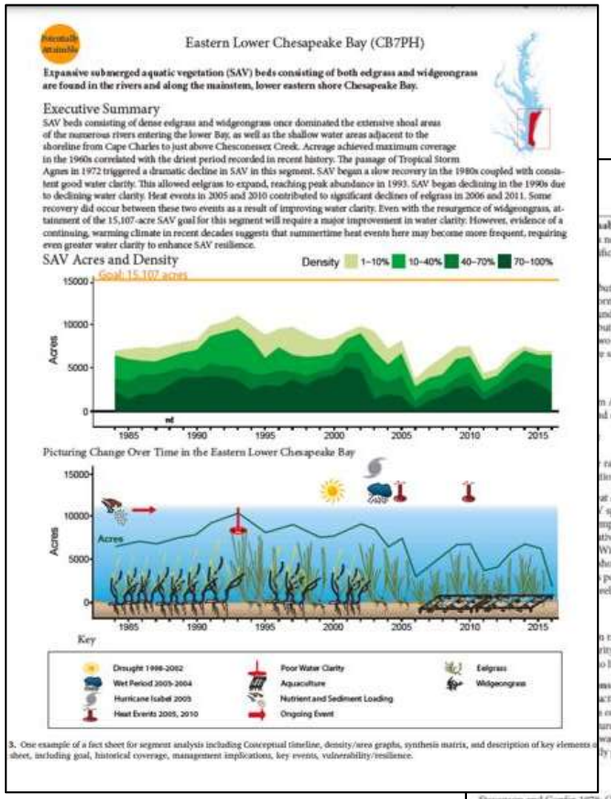
SAV % cover

SAV SYN produced scientific papers and fact sheets

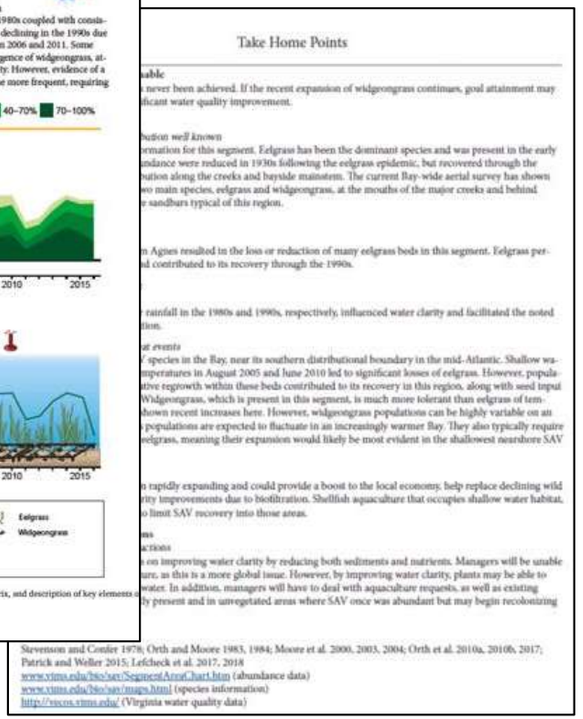


Nutrient reductions lead to unprecedented recovery of a temperate coastal ecosystem

Jonathan S. Lefcheck[1,2*], Robert J. Orth[2], William C. Dennison[3], David J. Wilcox[2], Rebecca R. Murphy[4], Jennifer Keisman[5], Cassie Gurbisz[6,7], Michael Hannam[8,9], J. Brooke Landry[10], Kenneth A. Moore[2], Christopher J. Patrick[11], Jeremy Testa[12], Donald E. Weller[8], Richard A. Batuik[13]



3. One example of a fact sheet for segment analysis including Conceptual timeline, density/area graphs, synthesis matrix, and description of key elements of sheet, including goal, historical coverage, management implications, key events, vulnerability/resilience.



Large media coverage achieved

Energy and Environment

The Chesapeake's 'secret garden' is thriving again, but Trump could end that

By Darryl Fears March 5 Email the author

Eelgrass in the Chesapeake Bay in summer 2017. (Photo by Jon Lefcheck)

The Post's View • Opinion

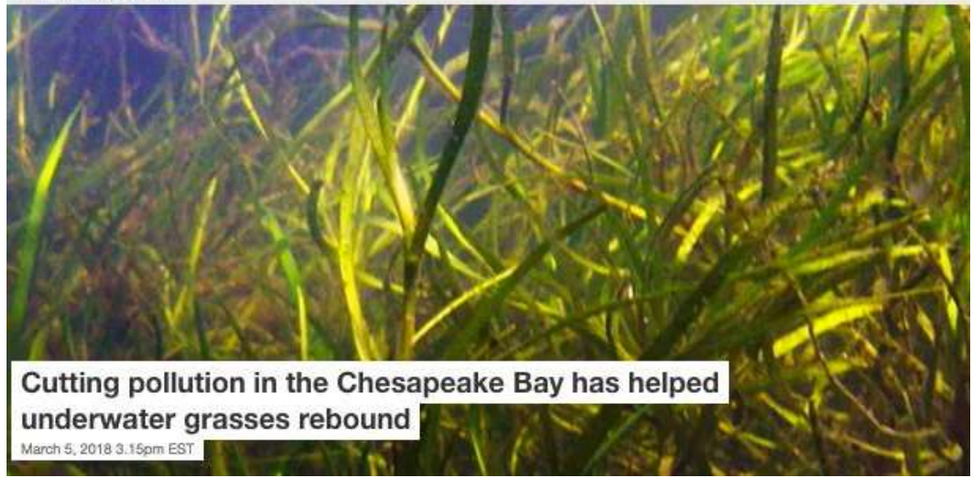
Why the Chesapeake Bay is the best in the world

THE CONVERSATION

Academic rigor, journalistic flair

Search analy

Arts + Culture Economy + Business Education Environment + Energy Ethics + Religion Health + Medicine Politics + Society Science + Technology

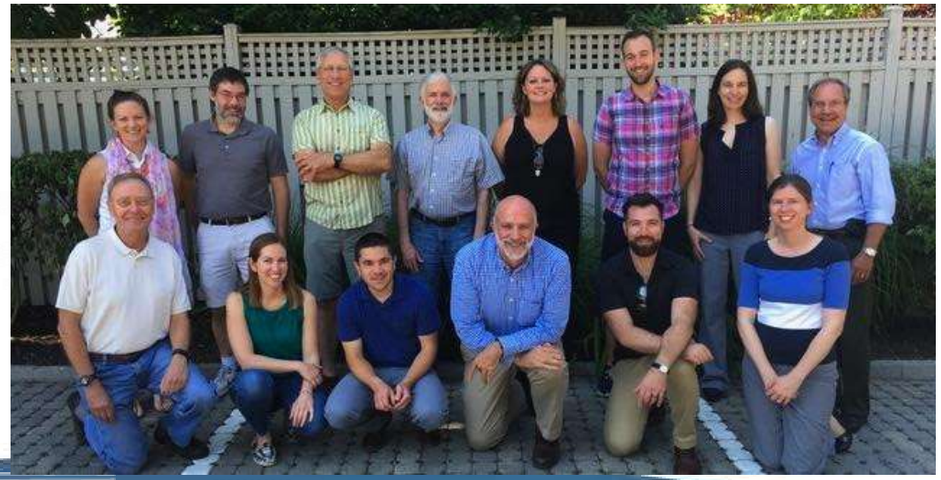


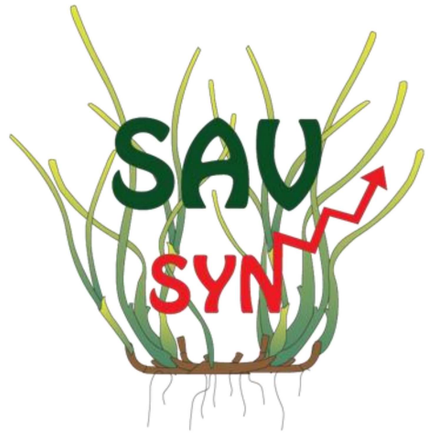
Cutting pollution in the Chesapeake Bay has helped underwater grasses rebound

March 5, 2018 3.15pm EST

Washington Post editorial supporting Chesapeake Bay Program
56 M people exposed to story via traditional and social media

Legacy = people and funding





Acting U.S. EPA administrator wants to keep Great Lakes restoration program

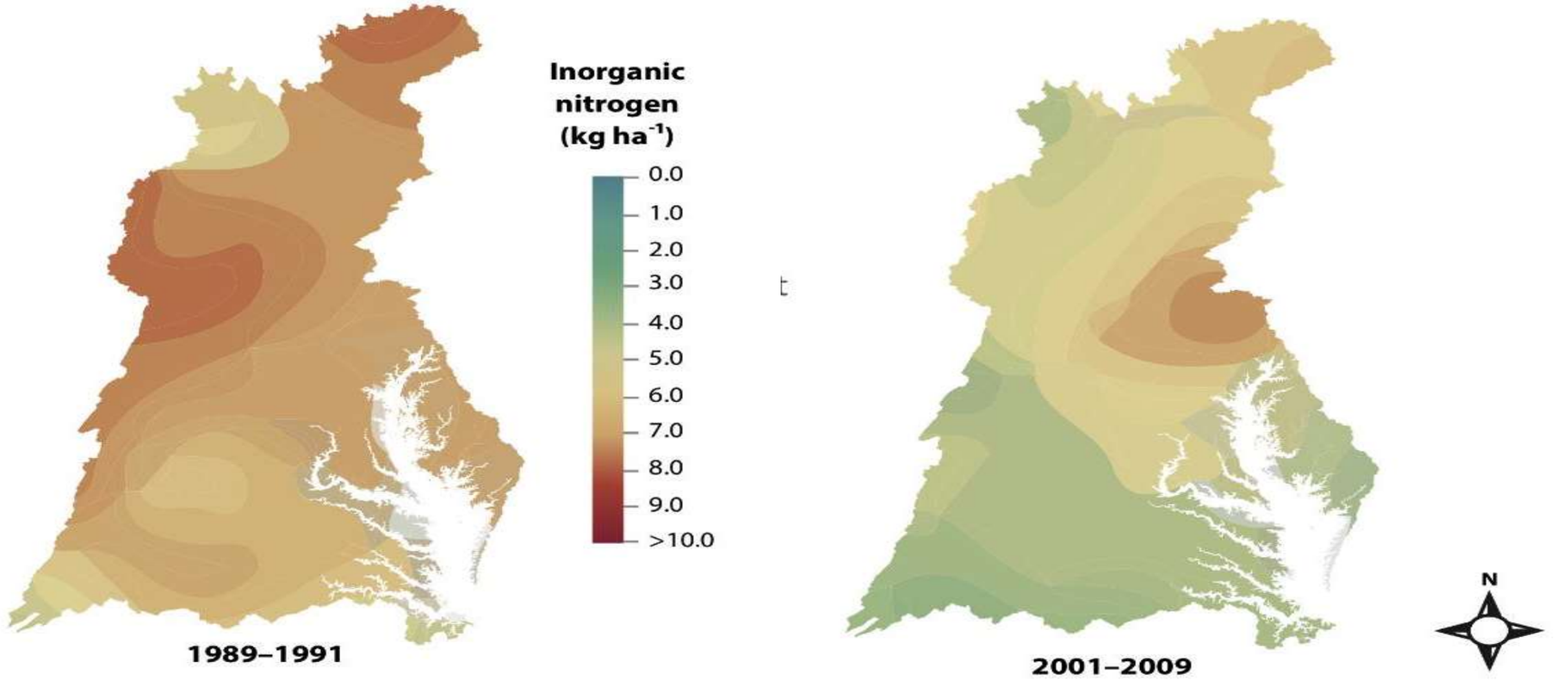
TOM HENRY
The Blade
thenry@theblade.com

AUG 18, 2018 | 1:06 AM

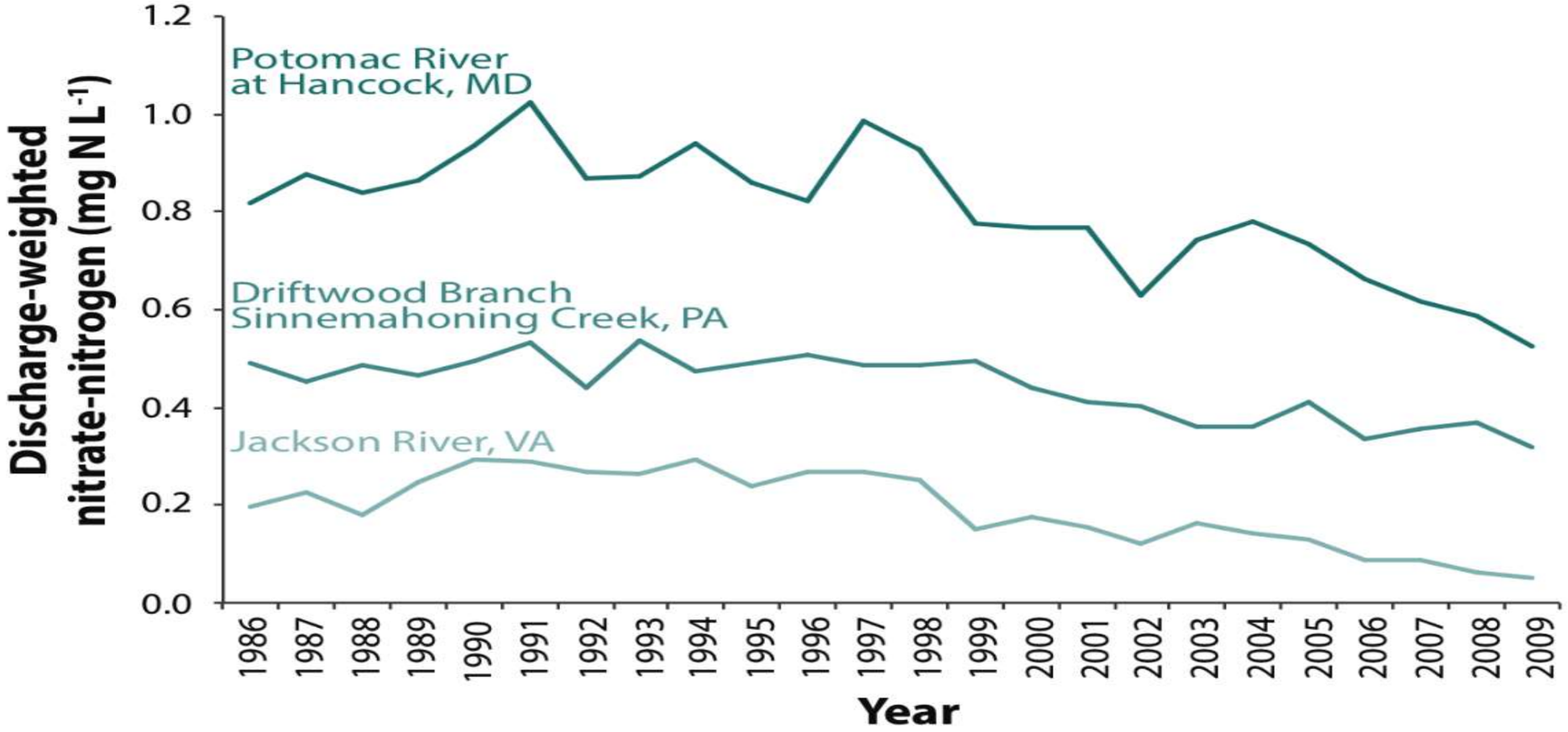
The $300 million-a-year Great Lakes Restoration Initiative is one Obama-era program that will survive the Trump Administration if the U.S. Environmental Protection Agency's new acting administrator, Andrew Wheeler, gets his way.

And, from Mr. Wheeler's perspective, Chesapeake Bay's highly aggressive cleanup strategy — a strategy that mirrors the sort of regulations some U.S. EPA critics and others want to see implemented for western Lake Erie — has been a success.

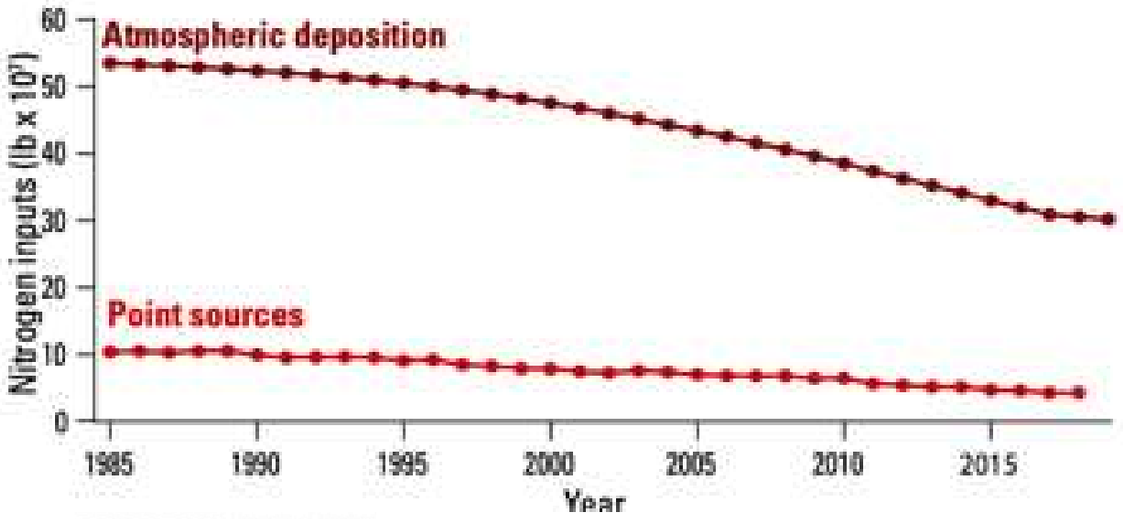
Improvements in air quality due to catalytic converters and smokestack scrubbers have resulted in reduced N deposition

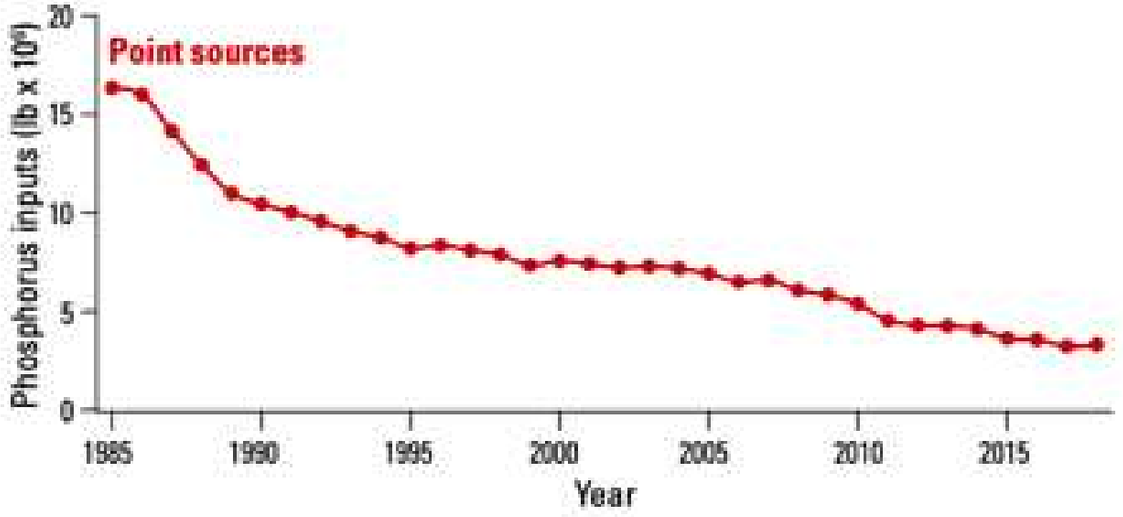


Reductions in N deposition are leading to stream nitrate reductions

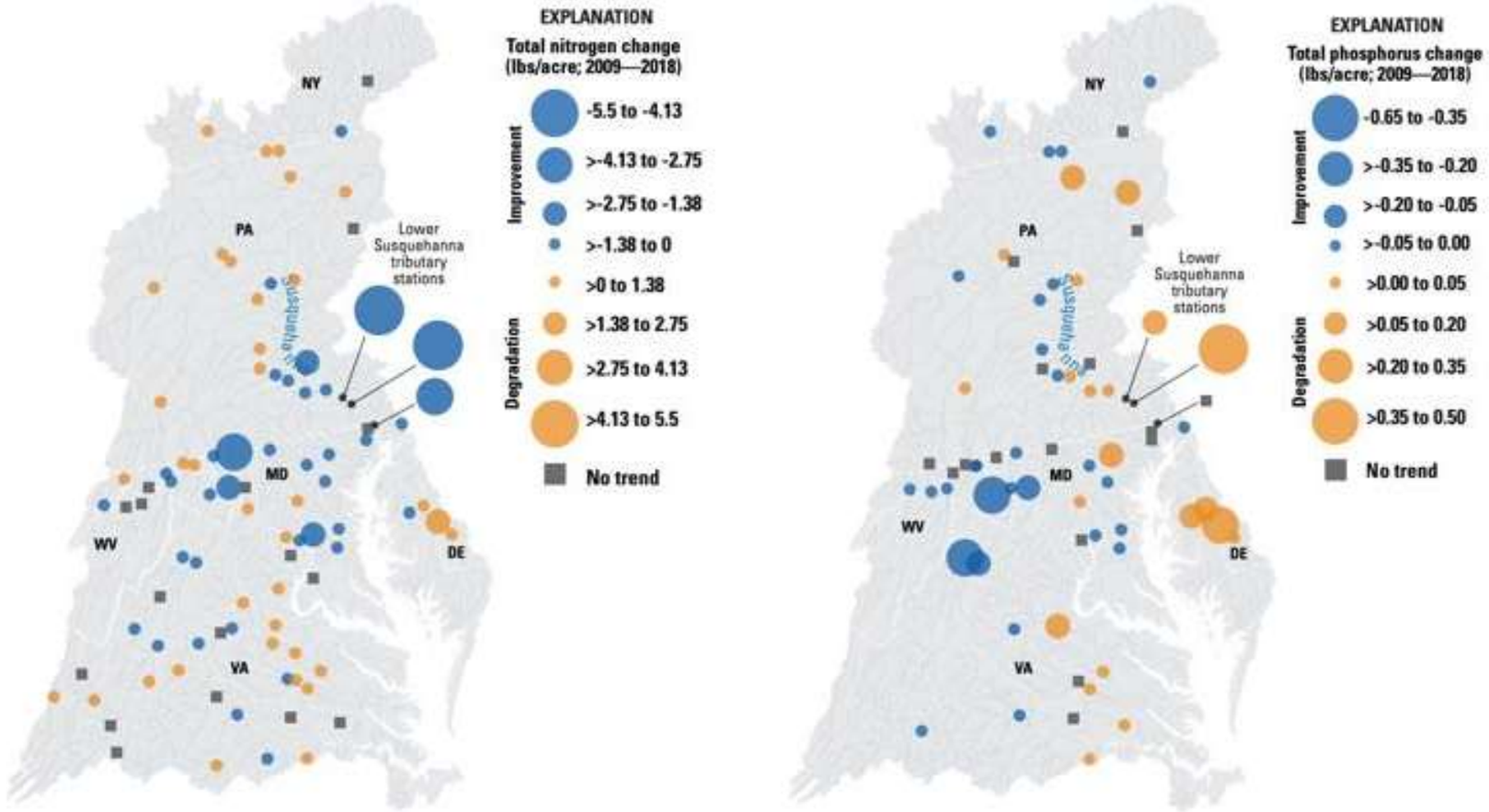


Nutrient reductions due to sewage upgrades and reduced NOx emissions





Nutrient trends in nontidal Chesapeake watershed (2009-2018)

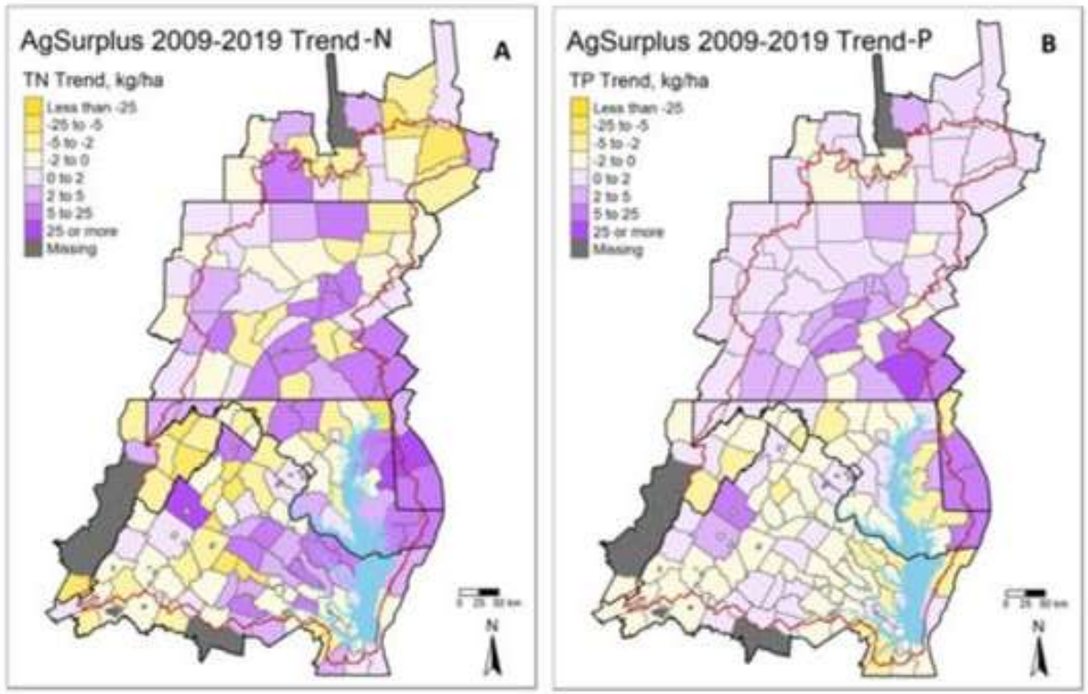


Recent increases in agricultural surpluses observed

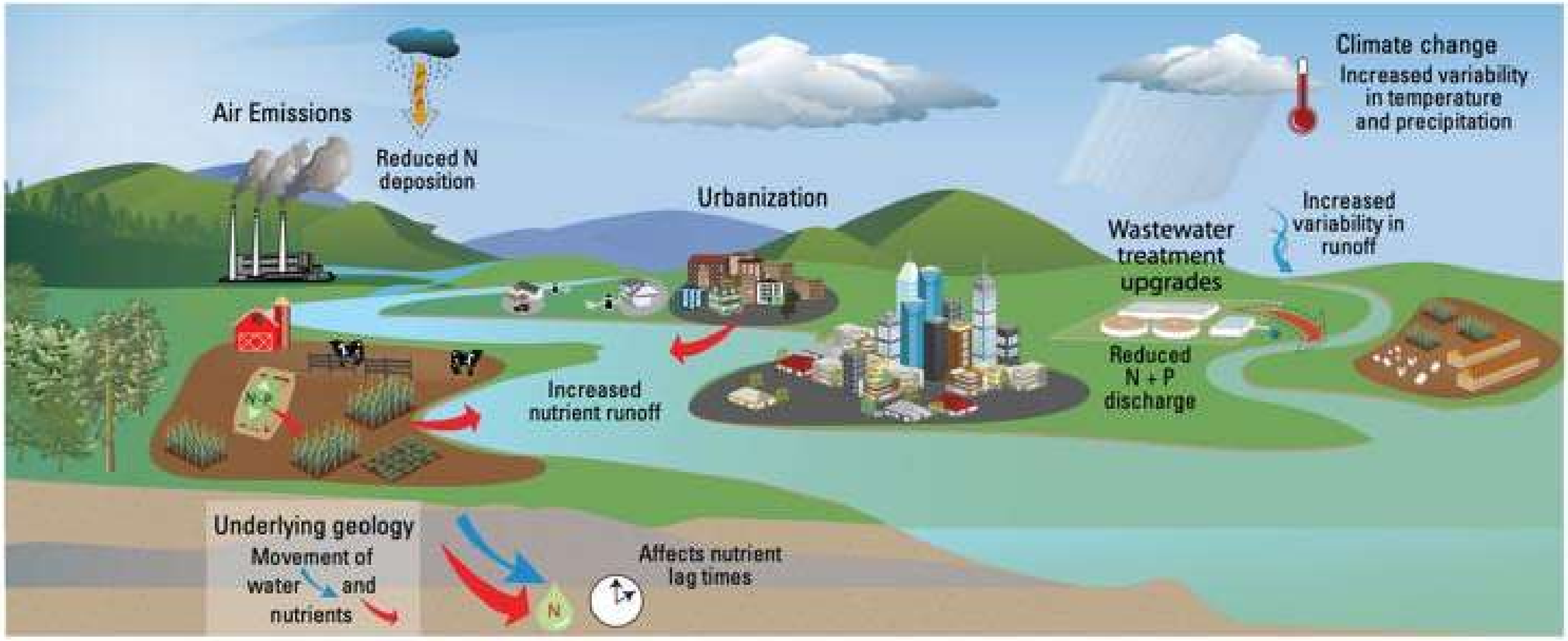
Major point and nonpoint sources of nutrient pollution to surface water have declined throughout the Chesapeake Bay watershed

Robert D Sabo[1], Breck Sullivan[2], Cuiyin Wu[3], Emily Trentacoste[4], Qian Zhang[5], Gary W Shenk[6], Gopal Bhatt[7] and Lewis C Linker[4]

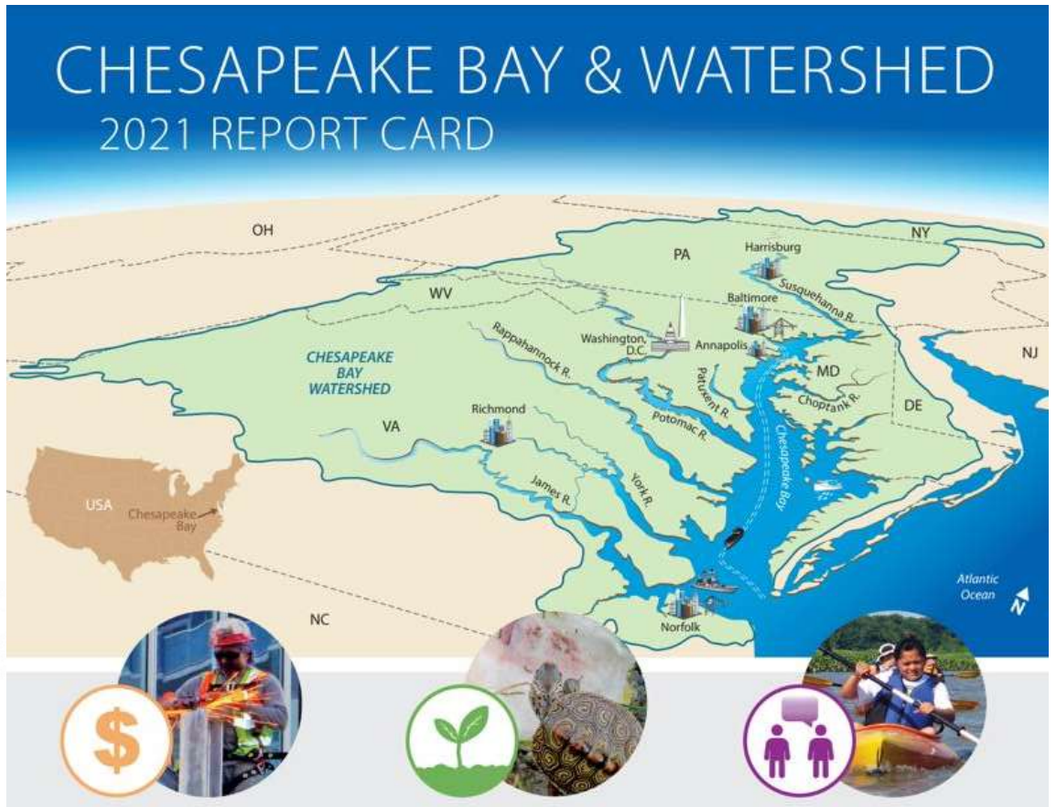
[1] U.S. Environmental Protection Agency, Office of Research and Development, Center for Public H
Washington, DC, United States of America
[2] U.S. Geological Survey, Chesapeake Research Consortium, Chesapeake Bay Program Office, Annap
[3] ERT, Inc., Laurel, MD, United States of America
[4] U.S. Environmental Protection Agency, Office of Research and Development, Immediate Of
Washington, DC, United States of America
[5] University of Maryland Center for Environmental Science, Chesapeake Bay Program Office, Annap
[6] U.S. Geological Survey, Chesapeake Bay Program Office, Annapolis, MD, United States of America
[7] Pennsylvania State University, Chesapeake Bay Program Office, Annapolis, MD, United States of An

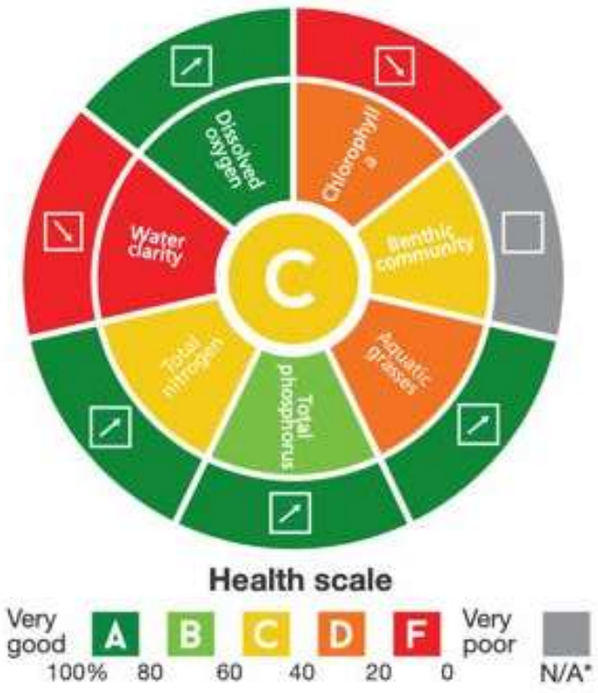


Nutrient cycling in Chesapeake

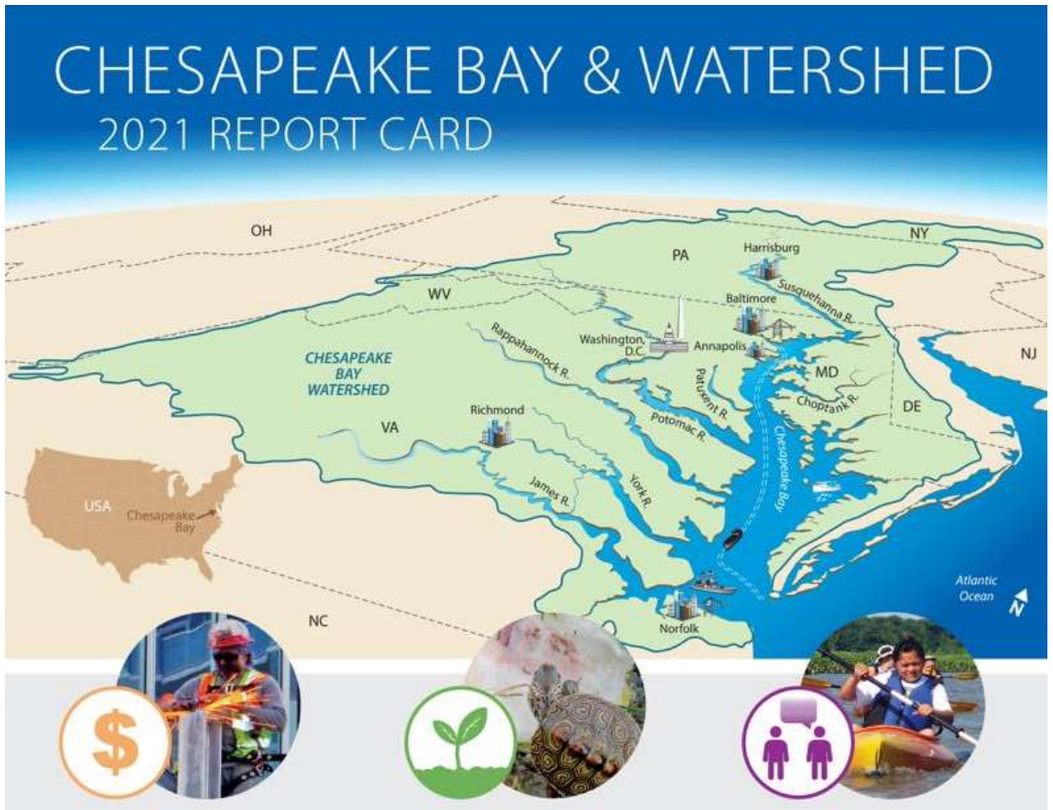


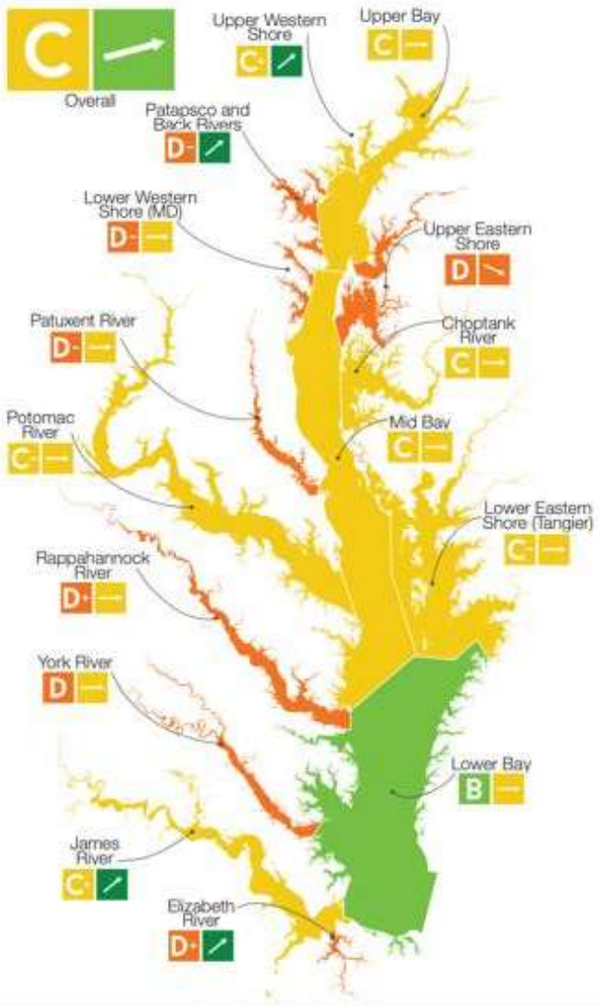
Chesapeake report card shows positive trajectories for nutrients, SAV & DO; degradation in water clarity & chlorophyll



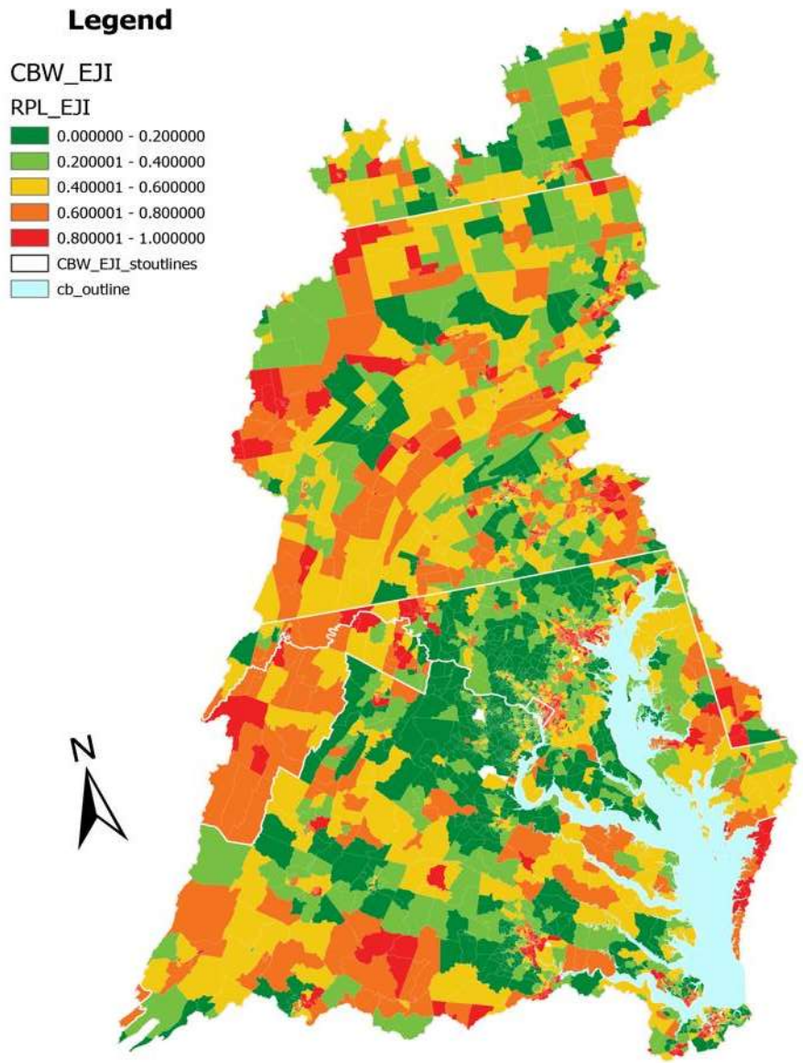


Baywide report card scores improving; 4 reporting regions improving; 10 no change; 1 degrading

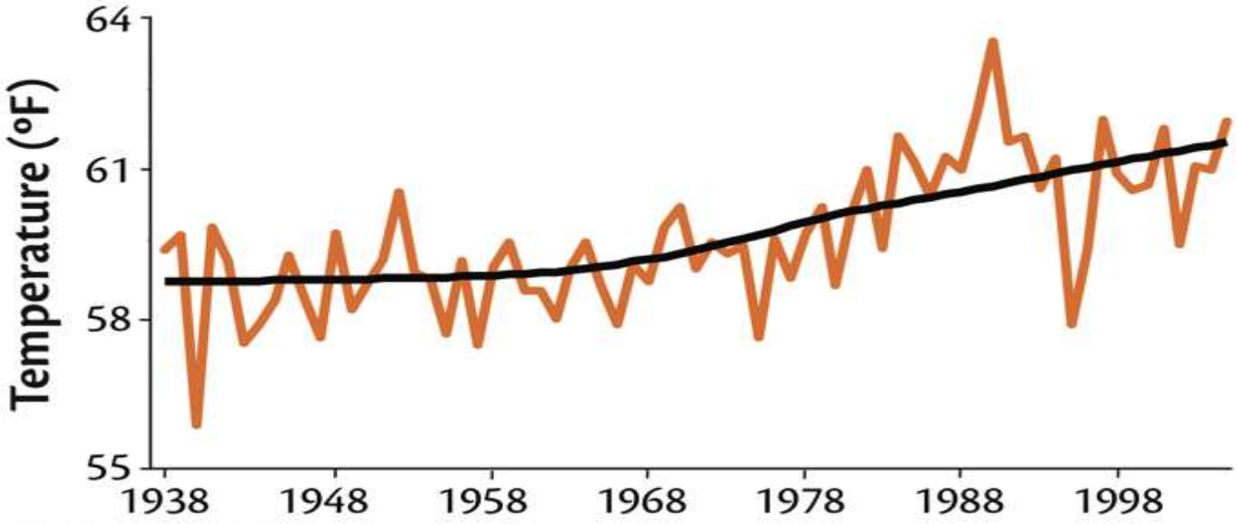


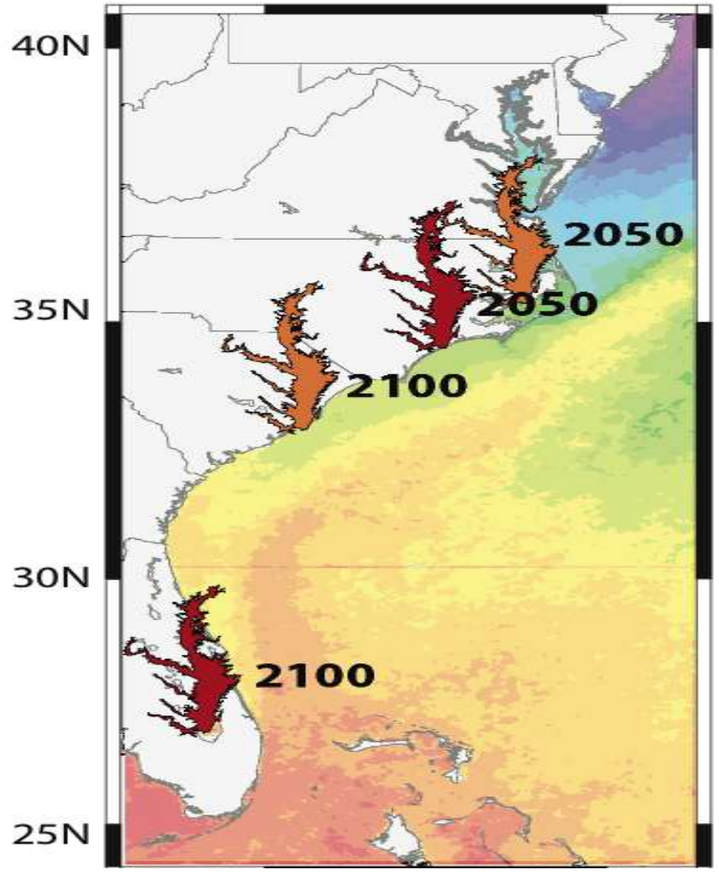


Environmental Justice has become part of our assessments of the Chesapeake watershed

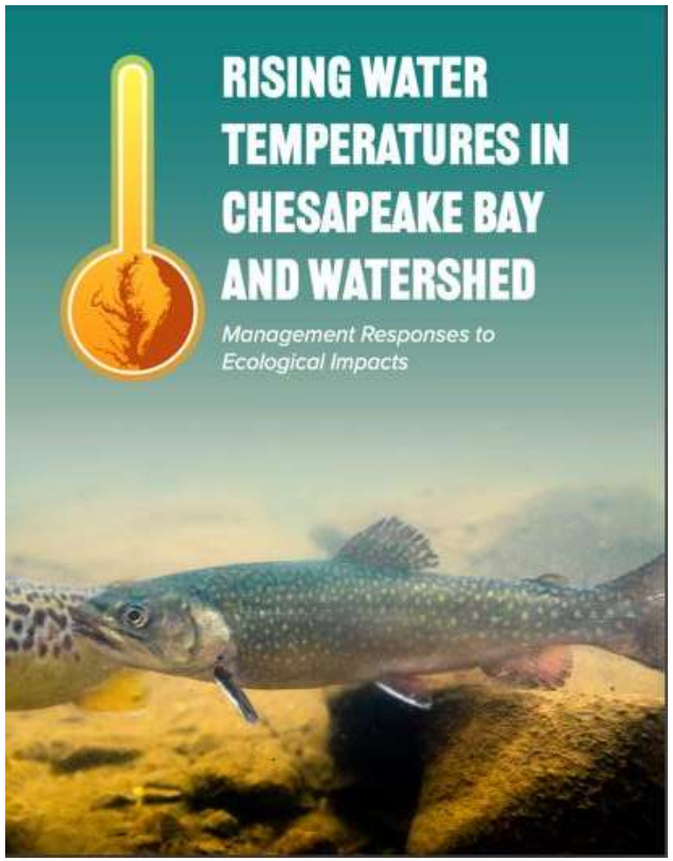


Climate change is affecting Chesapeake Bay





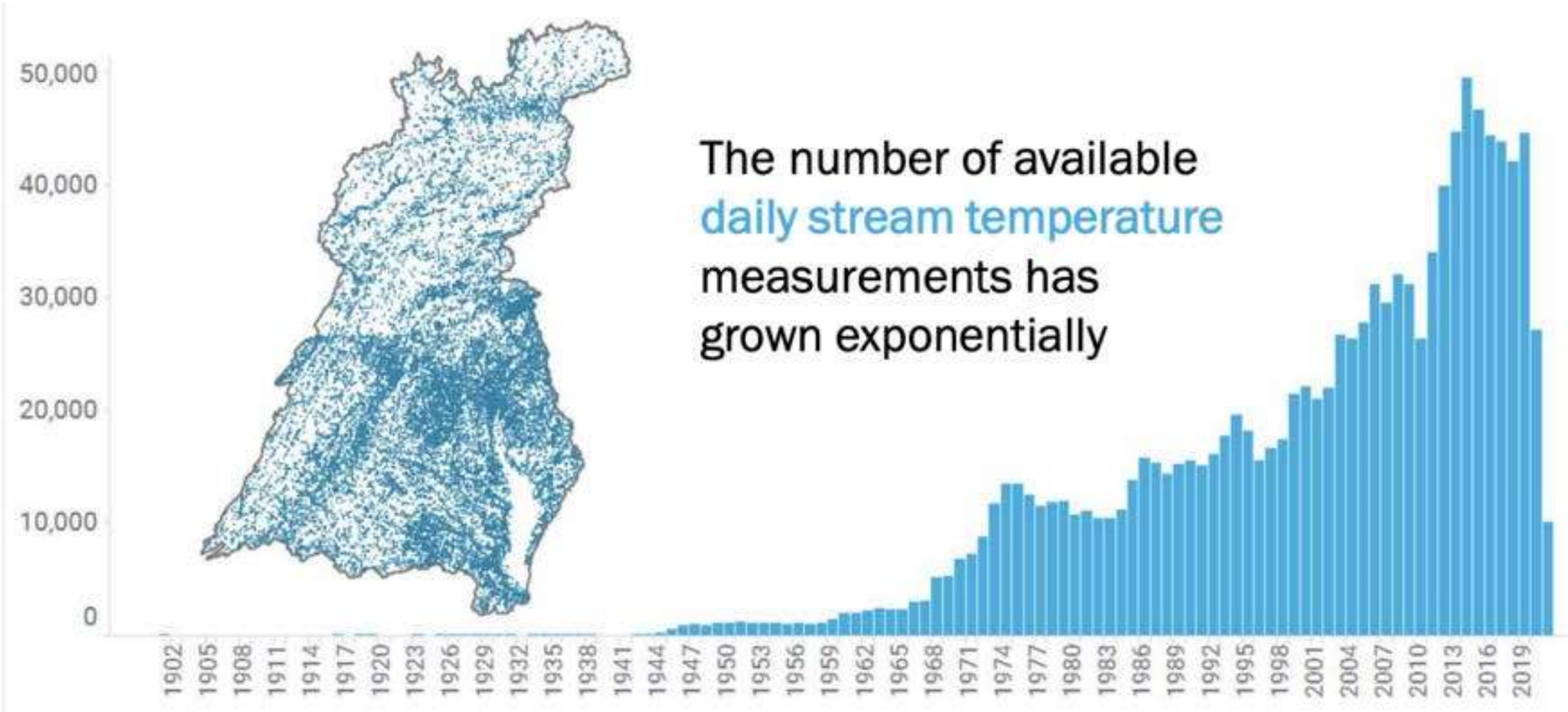
Rising temperature STAC workshop



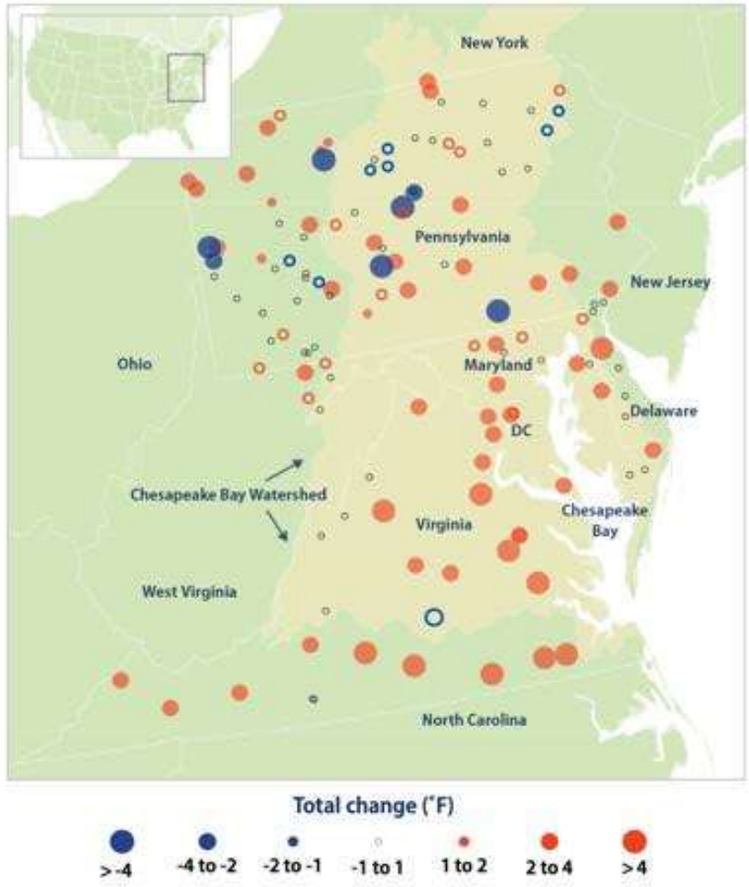
Rebecca Hamner
Former CBP Director

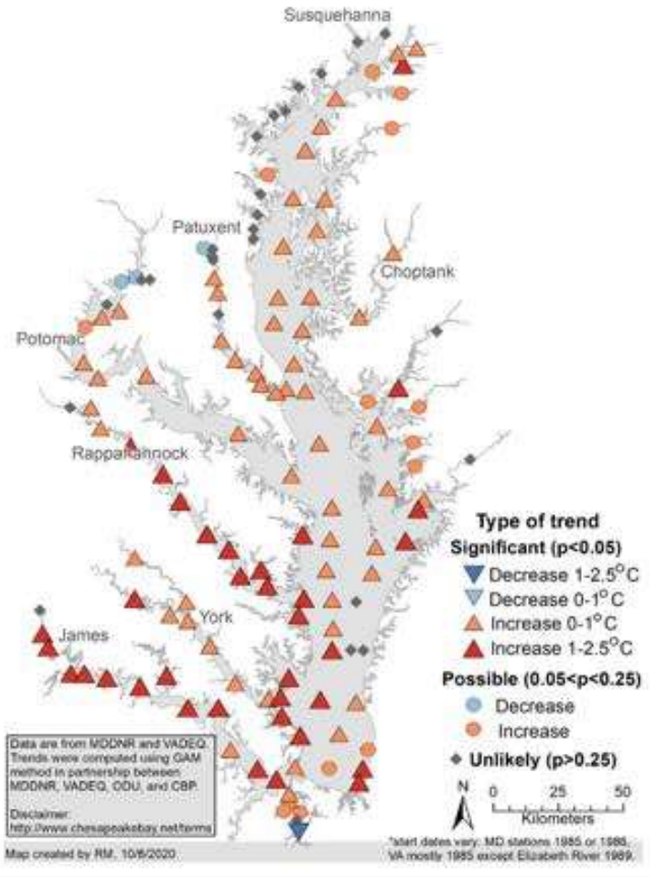
Rich Batiuk
Former CBP Associate Director

Expansion of monitoring is occurring



Water temperatures are rising throughout the watershed and throughout the Bay



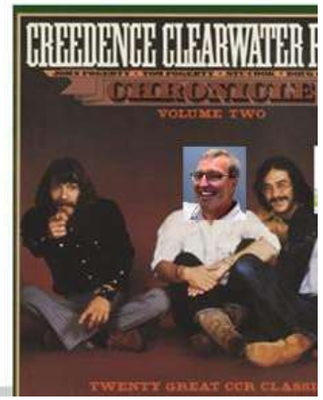


Recommendations from the rising temperatures STAC workshop

Rising temperature workshop resulted in TWO songs

Temperature on the Rise

Bill Dennison & Scott Phillips



20 May 2021

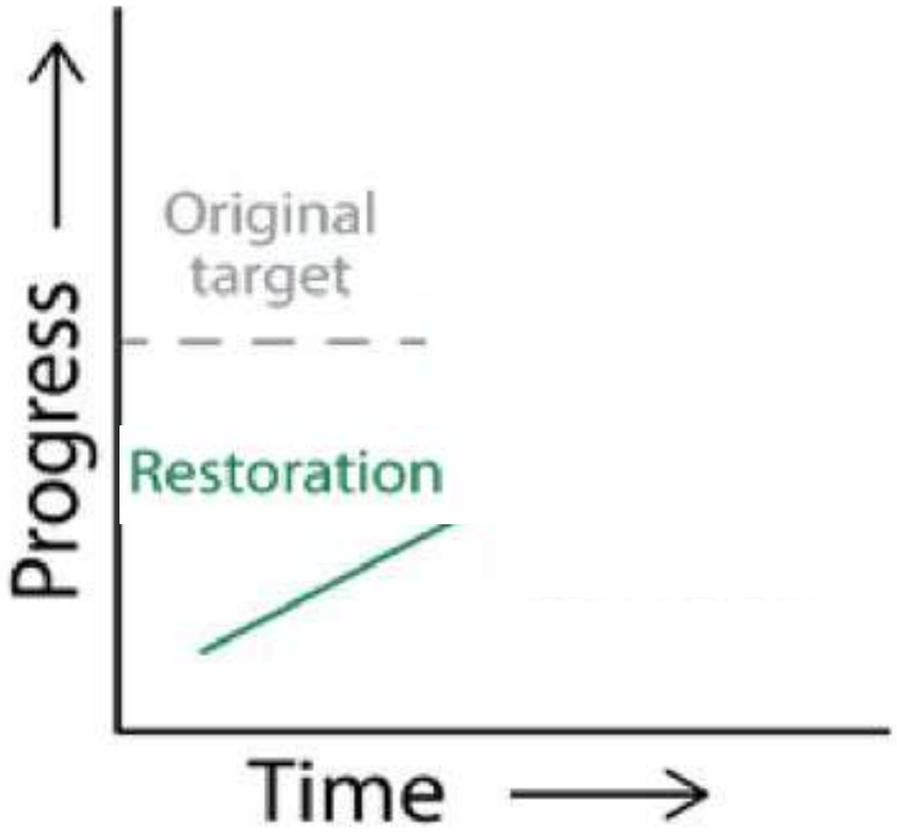
Heat Waves

by

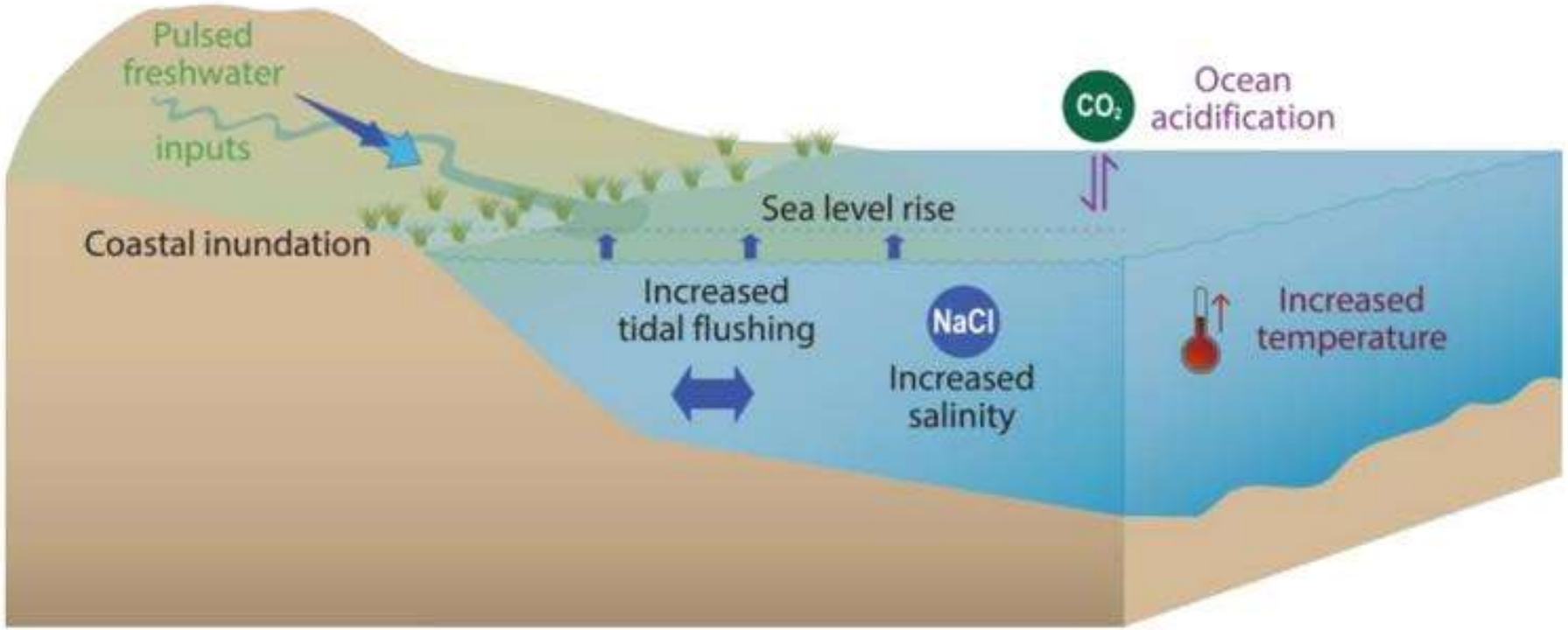
Bruce Vogt & Bill Dennison

12 Jan 2022

Restoration targets

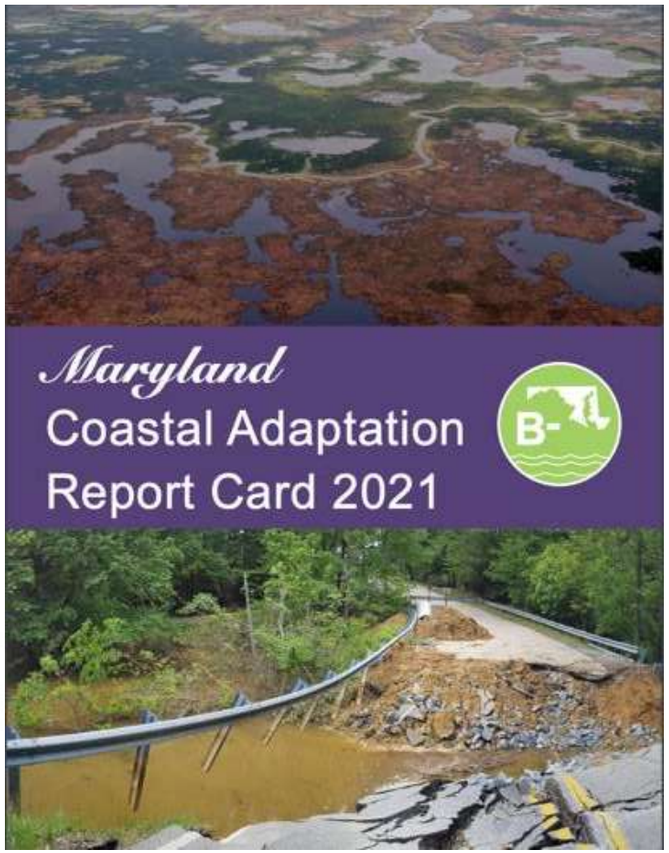


Climate change impacts affect restoration

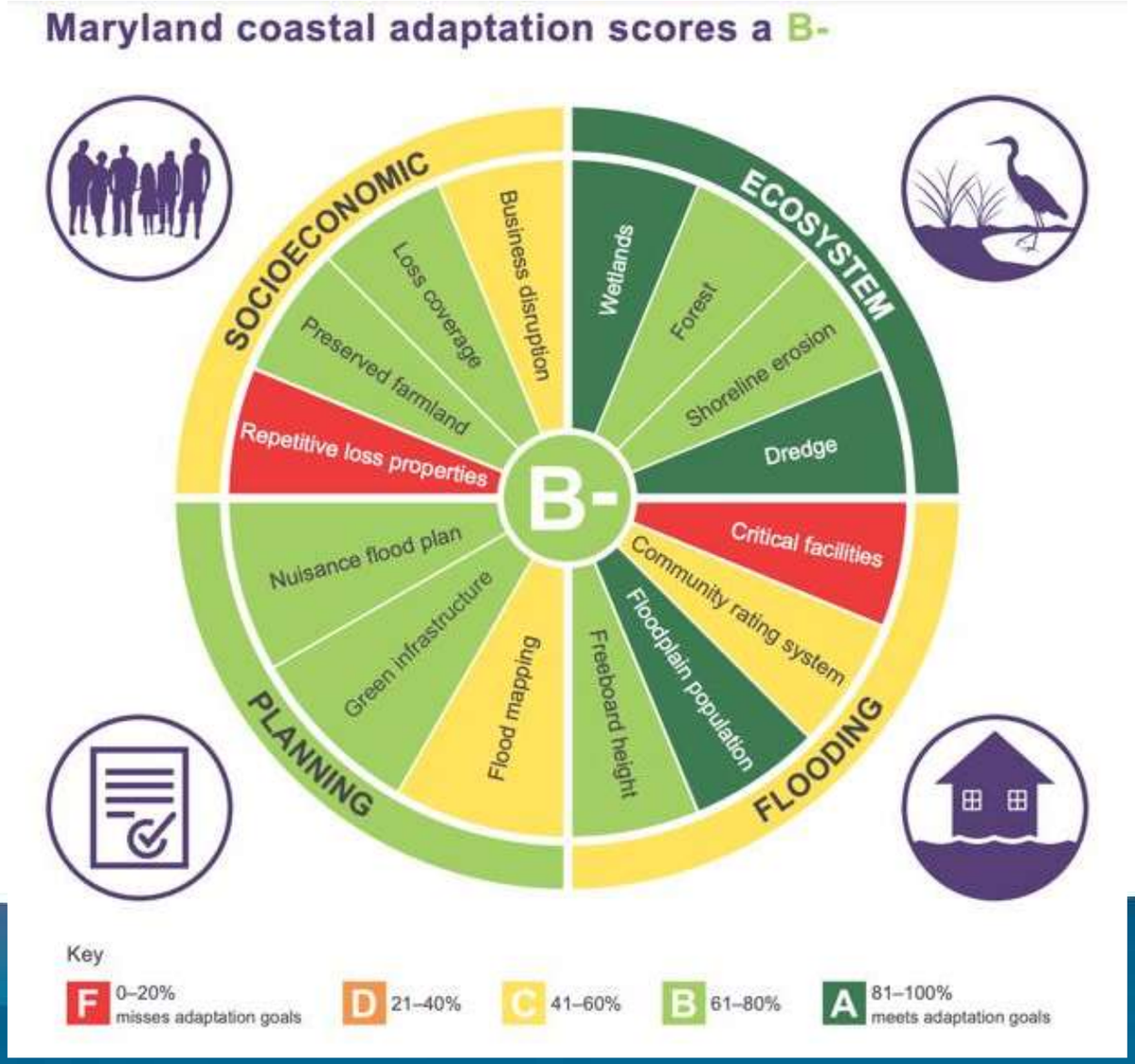


Climate change impacts require accelerated restoration

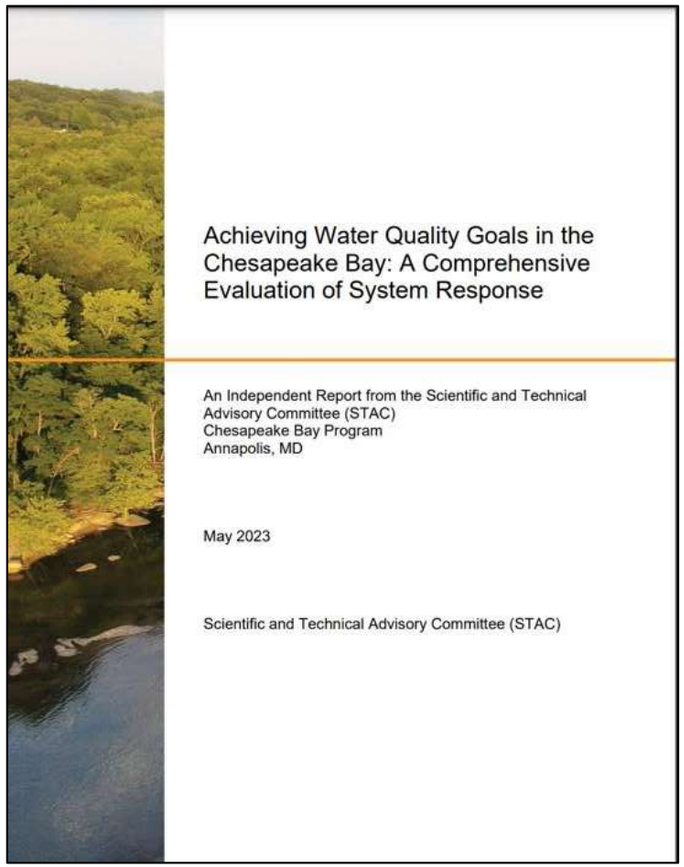
Maryland coastal adaptation report card produced

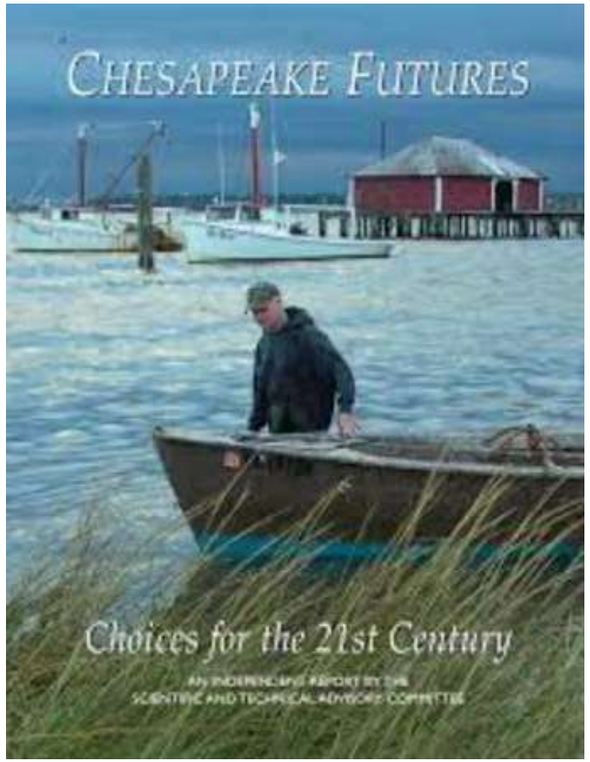


We should consider a Bay wide assessment of coastal resilience

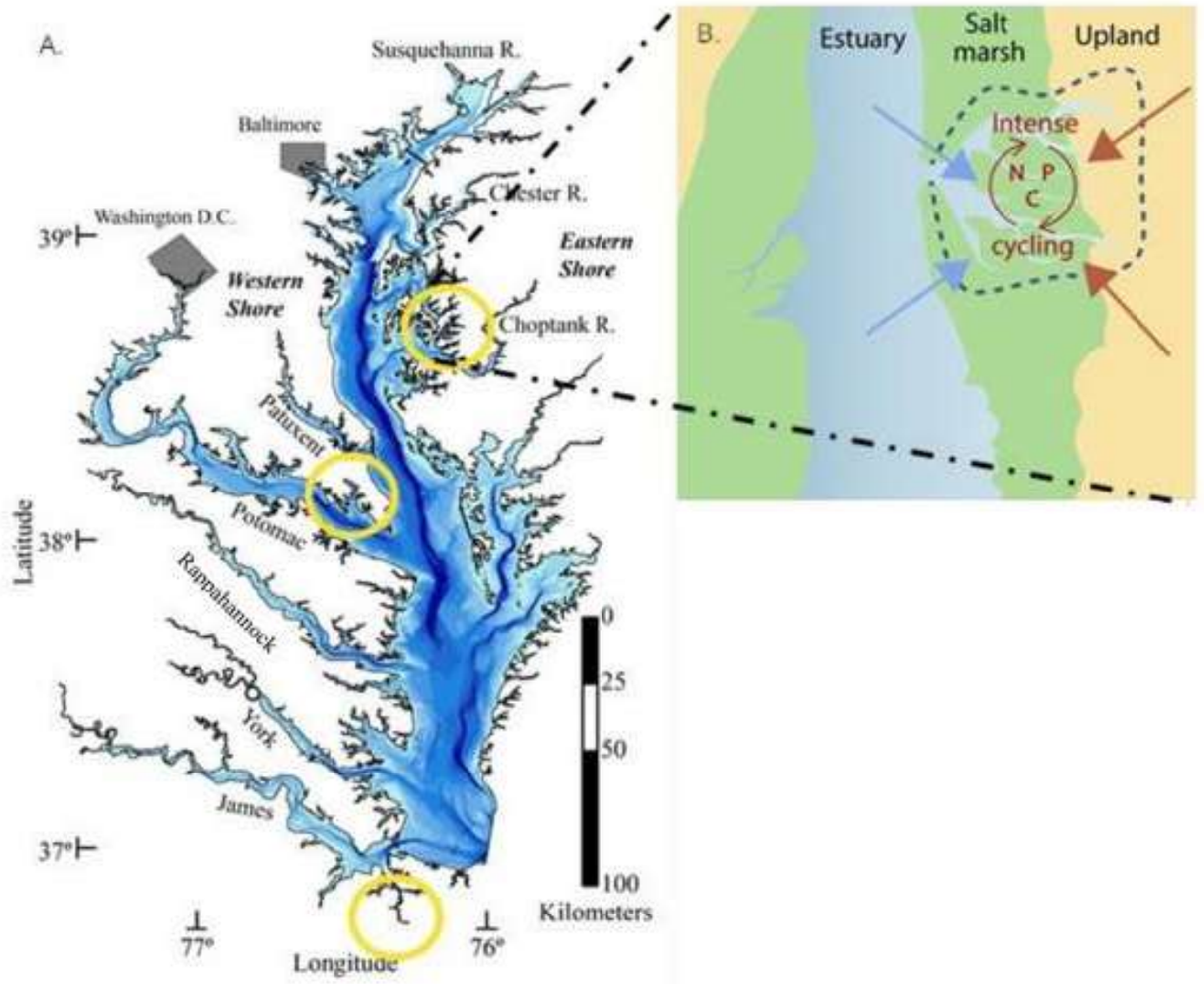


CESR report is the most significant STAC output since Chesapeake Futures (2003)

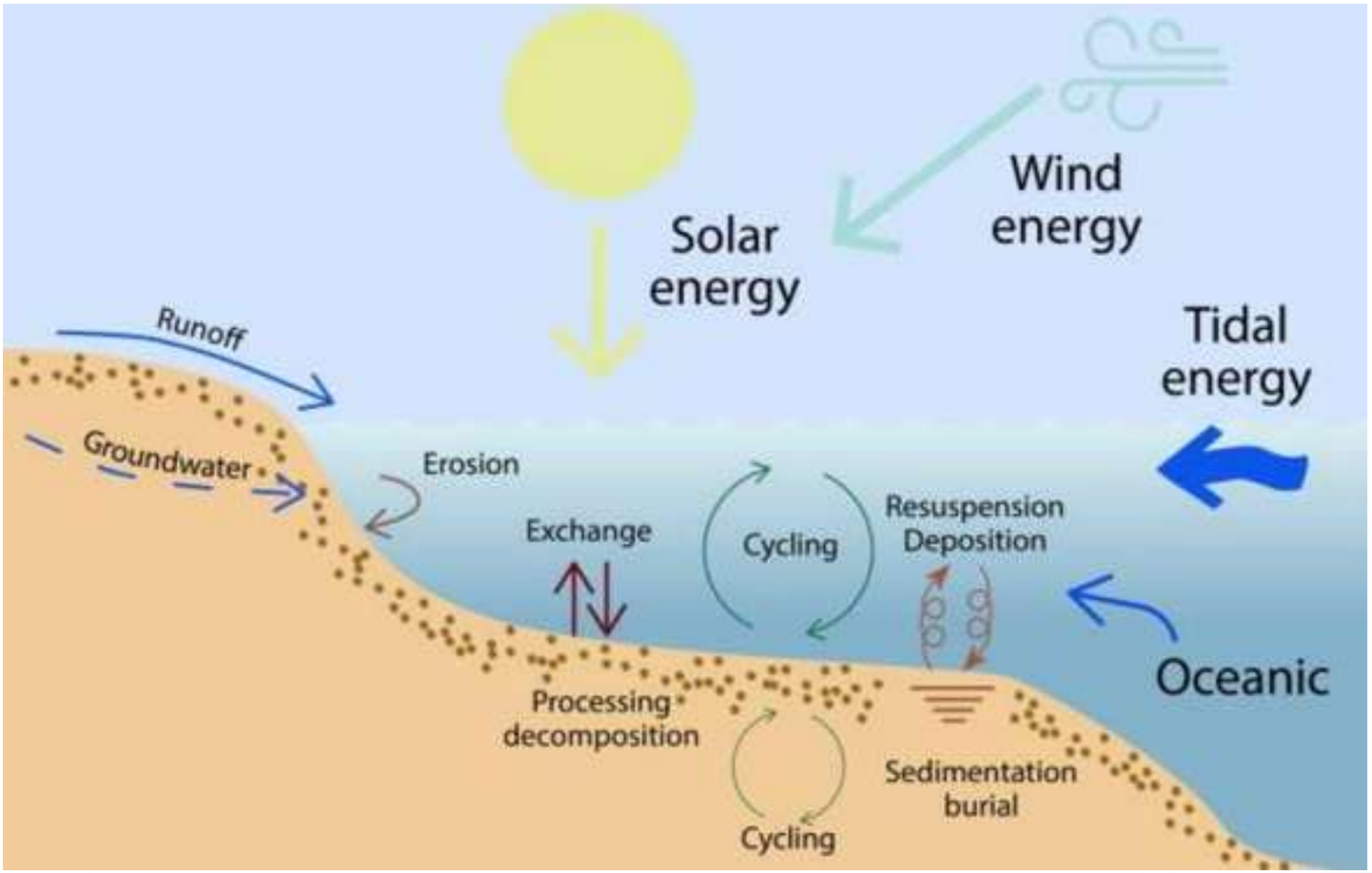




Transition zones: Intensive cycling; vulnerable to sea level rise and other climate change impacts; abundant in Chesapeake



Shallow water = key interface



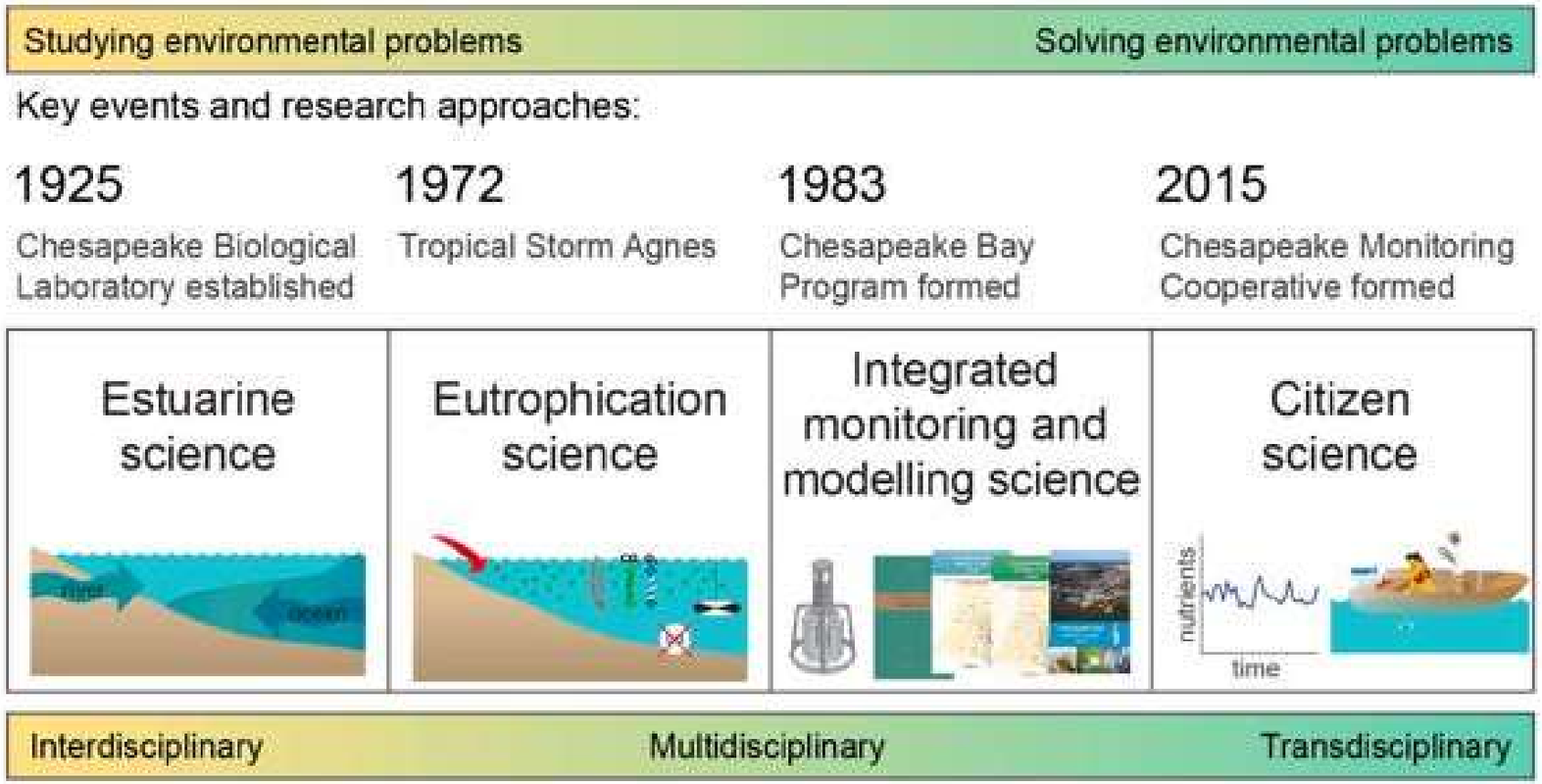
Developing new ways to achieve water quality goals

Citizen science is blossoming in Chesapeake Bay and Watershed

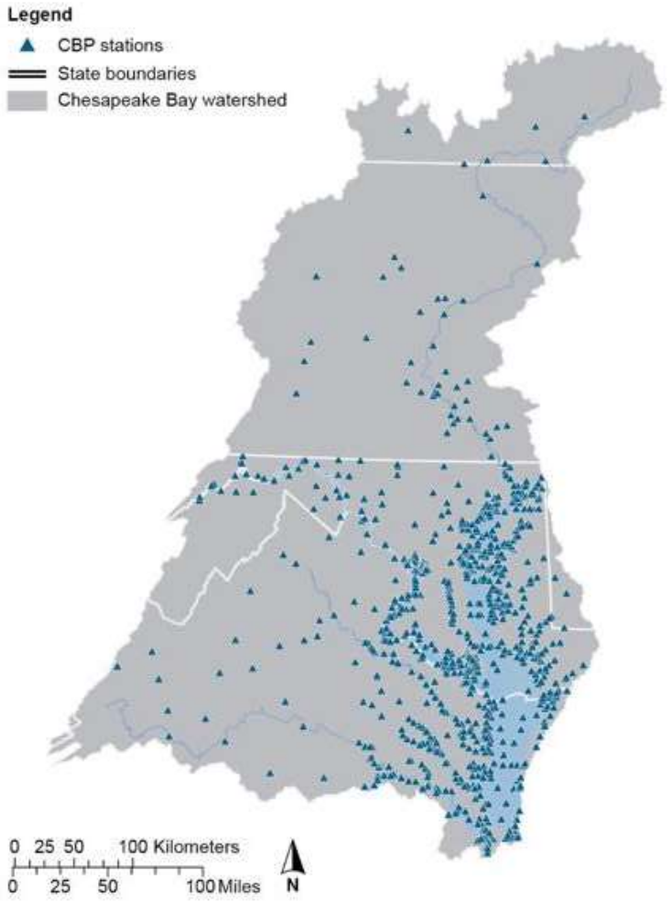
Chesapeake Dolphin Watch

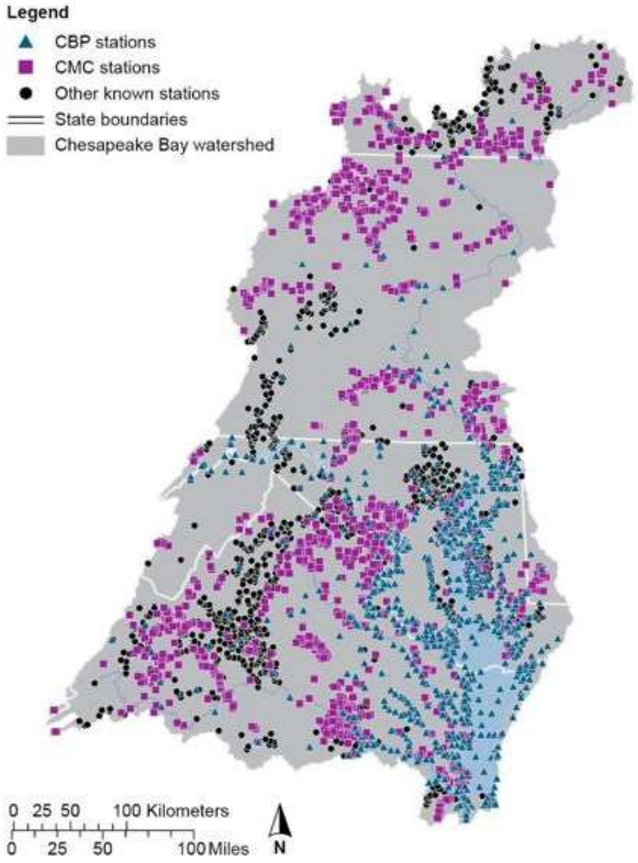
Chesapeake Bay SAV WATCHERS

Citizen science is part of the evolution of Chesapeake science

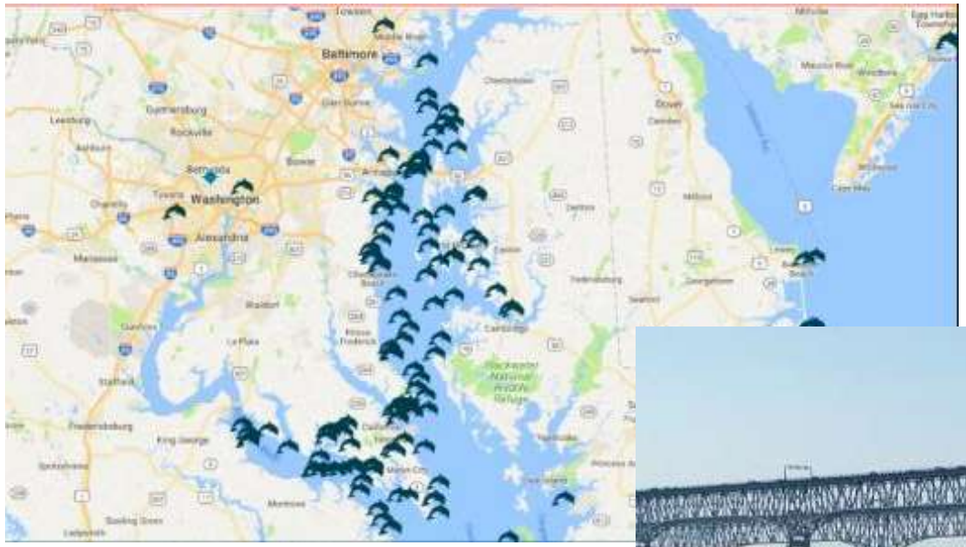


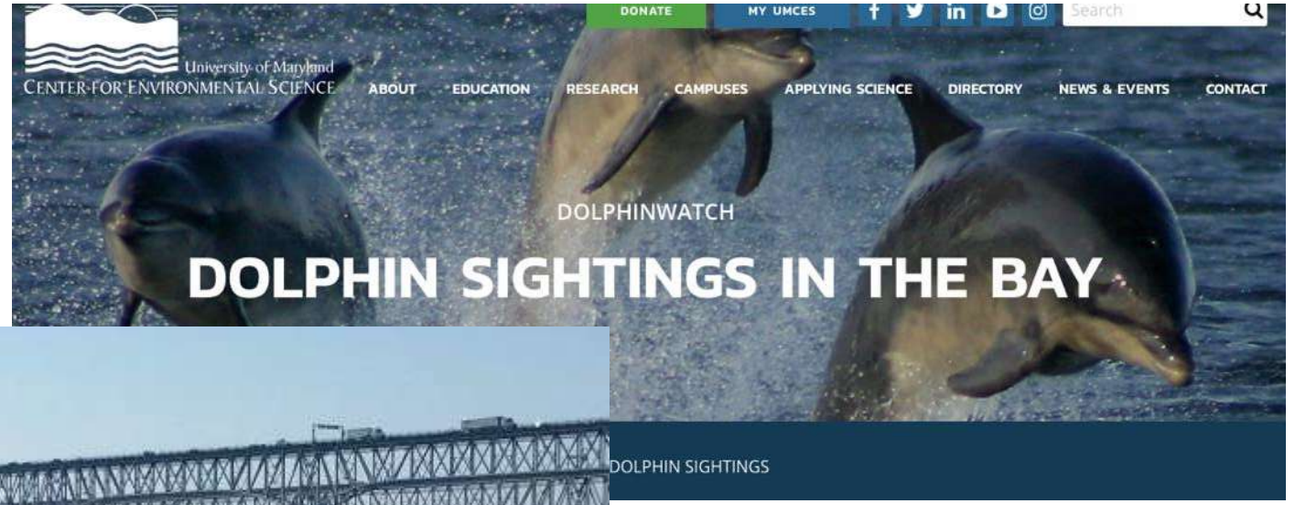
Citizen science increases sampling density



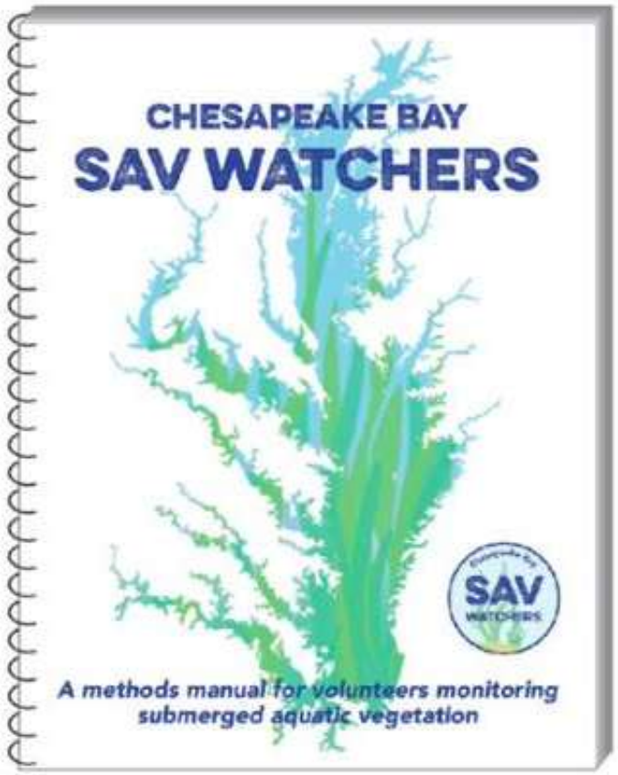


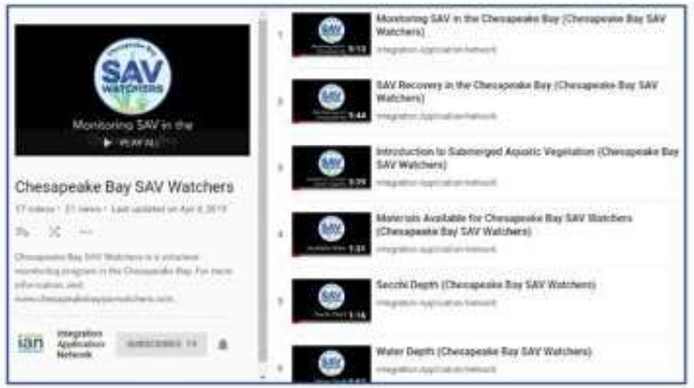
DolphinWatch tracks dolphin sightings in Chesapeake Bay

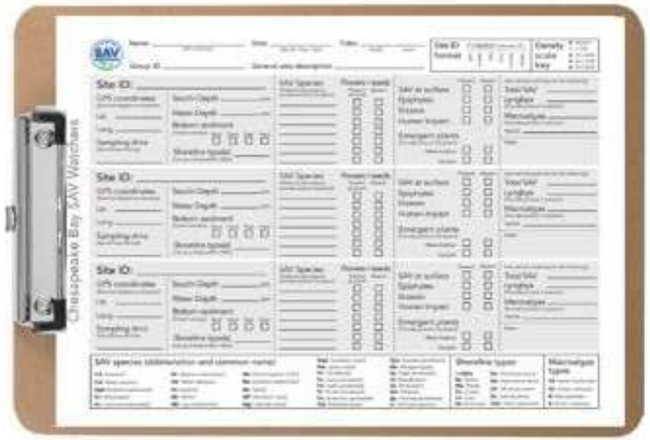




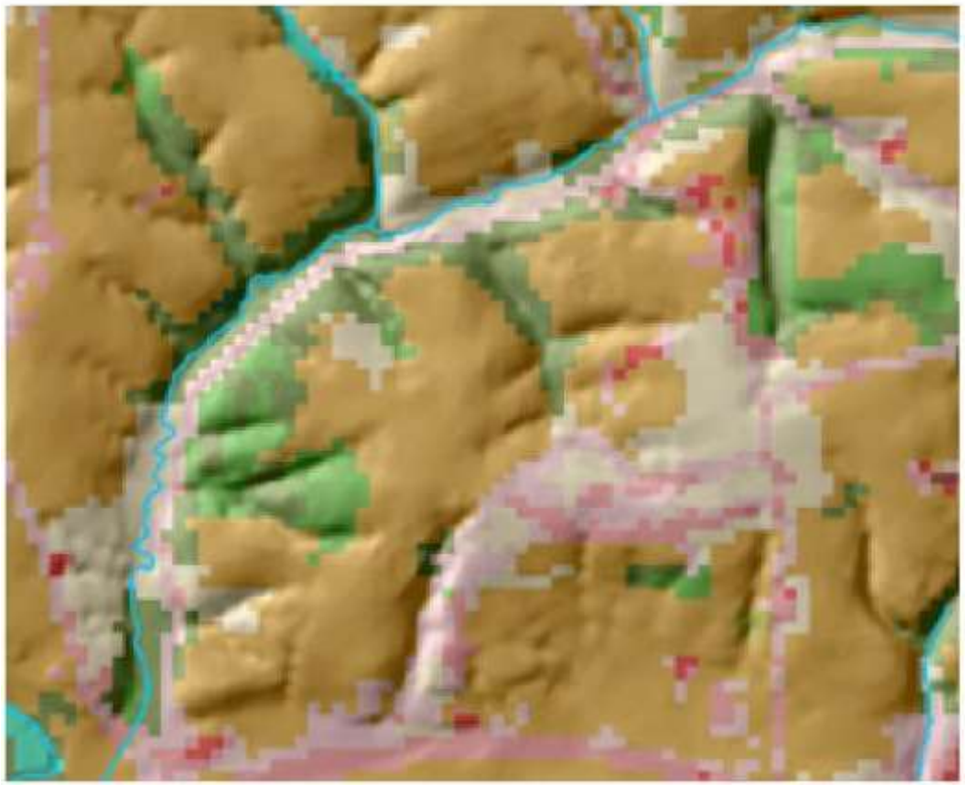
SAV Watchers program: Ground-truthing for remote sensing







One meter resolution land use mapping achieved



30 m resolution

1 m resolution

Acceleration in Chesapeake publications

Academia

JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION
Vol. 58, No. 6 AMERICAN WATER RESOURCES ASSOCIATION December 2022

Extent and Causes of Chesapeake Bay Warming

Kyle E. Hinson, Marjorie A.M. Friedrichs, Pierre St-Laurent, Fei Da, and Raymond G. Najjar

Research Impact Statement: Since 1985, the Chesapeake Bay has warmed three to four times faster in warmer than cooler months; this has been driven primarily by atmospheric changes and by ocean warming in the lower Bay.

ABSTRACT: Coastal environments such as the Chesapeake Bay have long been impacted by eutrophication stressors resulting from human activities, and these impacts are now being compounded by global warming trends. However, there are few studies documenting long-term estuarine temperature change and the relative contributions of rivers, the atmosphere, and the ocean. In this study, Chesapeake Bay warming, since 1985, is quantified using a combination of cruise observations and model outputs, and the relative contributions to that warming are estimated via numerical sensitivity experiments with a watershed–estuarine modeling system. Throughout the Bay's main stem, similar warming rates are found at the surface and bottom between the late 1980s and late 2010s (0.02 ± 0.02°C/year, mean ± 1 standard error), with elevated summer rates (0.04 ± 0.01°C/year) and lower rates of winter warming (0.01 ± 0.01°C/year). Most (~85%) of this estuarine warming is driven by atmospheric effects. The secondary influence of ocean warming increases with proximity to the Bay mouth, where it accounts for more than half of summer warming in bottom waters. Sea level rise has slightly reduced summer warming, and the influence of riverine warming has been limited to the heads of tidal tributaries. Future rates of warming in Chesapeake Bay will depend not only on global atmospheric trends, but also on regional circulation patterns in mid-Atlantic waters, which are currently warming faster than the atmosphere.

(KEYWORDS: Chesapeake Bay; climate change; water temperature; environmental models.)

INTRODUCTION

Increasing temperatures in the marine environment are a globally recognized phenomenon, with the world's oceans accounting for approximately 93% of the total increase in global heat content due to the effects of anthropogenic warming in the atmosphere since 1970 (Levitus et al. 2012; Rhein et al. 2013). Compared to the open ocean, warming patterns in the coastal ocean are much less uniform spatially and temporally (Belkin 2009; Lima and Wethey 2012; Liao et al. 2015; Alexander et al. 2018), which can make them more difficult to detect (Henson et al. 2016). Warming in coastal habitats is known to affect rates of biogeochemical cycling that can drive negative impacts like hypoxia (Breitburg et al. 2018; Fennel and Testa 2019). Rising temperatures over the past few decades have been linked to worsened water quality conditions in well-studied coastal

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REVIEWS AND ANALYSES
Journal of Environmental Quality

Factors driving nutrient trends in streams of the Chesapeake Bay watershed

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Abstract

Despite decades of effort toward reducing nitrogen and phosphorus flux to Chesapeake Bay, water-quality and ecological responses in surface waters have been mixed. Recent research, however, provides useful insight into multiple factors complicating the understanding of nutrient trends in bay tributaries, which we review in this paper, as we approach a 2025 total maximum daily load (TMDL) management deadline. Improvements in water quality in many streams are attributable to management actions that reduced point sources and atmospheric nitrogen deposition and to changes in climate. Nutrient reductions expected from management actions, however, have not been fully realized in watershed streams. Nitrogen from urban nonpoint sources has declined, although water-quality responses to urbanization in individual streams vary depending on predevelopment land use. Evolving agriculture, the largest watershed source of nutrients, has likely contributed to local nutrient trends but has not affected substantial changes in flux to the bay. Changing average nitrogen yields from farmland underlain by carbonate rocks, however, may suggest future trends in other areas under similar management, climatic, or other influences, although drivers of these changes remain unclear. Regardless of upstream trends, phosphorus flux to the bay from its largest tributary has increased due to sediment infill in the Conowingo Reservoir. In general, recent research emphasizes the utility of input reductions over attempts to manage nutrient fate and transport at limiting nutrients in surface waters. Ongoing research opportunities include evaluating effects of climate change and conservation practices over time and space and developing tools to disentangle and evaluate multiple influences on regional water quality.

1 | INTRODUCTION

Recent efforts toward reducing nutrient flux to Chesapeake Bay from its watershed have been insufficient to meet water-quality and ecological standards in the bay (Chesapeake Bay Program, 2018a; Kleinman et al., 2019; Linker,

Acceleration in Chesapeake publications

Academia
+
Federal agencies
+
CBP

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Nutrient limitation of phytoplankton in Chesapeake Bay: Development of an empirical approach for water-quality management

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ABSTRACT

Understanding the temporal and spatial roles of nutrient limitation on phytoplankton growth is necessary for developing successful management strategies. Chesapeake Bay has well-documented seasonal and spatial variations in nutrient limitation, but it remains unknown whether these patterns of nutrient limitation have changed in response to nutrient management efforts. We analyzed historical data from nutrient bioassay experiments (1992–2002) and data from long-term, fixed-site water-quality monitoring program (1990–2017) to develop empirical approaches for predicting nutrient limitation in the surface waters of the mainstem Bay. Results from classification and regression trees (CART) matched the seasonal and spatial patterns of bioassay-based nutrient limitation in the 1992–2002 period much better than two simpler, non-statistical approaches. An ensemble approach of three selected CART models satisfactorily reproduced the bioassay-based results (classification rate = 99%). This empirical approach can be used to characterize nutrient limitation from long-term water-quality monitoring data on much broader geographic and temporal scales than would be feasible using bioassays, providing a new tool for informing water-quality management. Results from our application of the approach to 21 tidal monitoring stations for the period of 2007–2017 showed modest changes in nutrient limitation patterns, with expanded areas of nitrogen-limitation and contracted areas of nutrient saturation (i.e., not limited by nitrogen or phosphorus). These changes imply that long-term reductions in nitrogen load have led to expanded areas with nutrient-limited phytoplankton growth in the Bay, reflecting long-term water-quality improvements in the context of nutrient enrichment. However, nutrient limitation patterns remain unchanged in the majority of the mainstem, suggesting that nutrient loads should be further reduced to achieve a less nutrient-saturated ecosystem.

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ADVANCED REVIEW
WILEY
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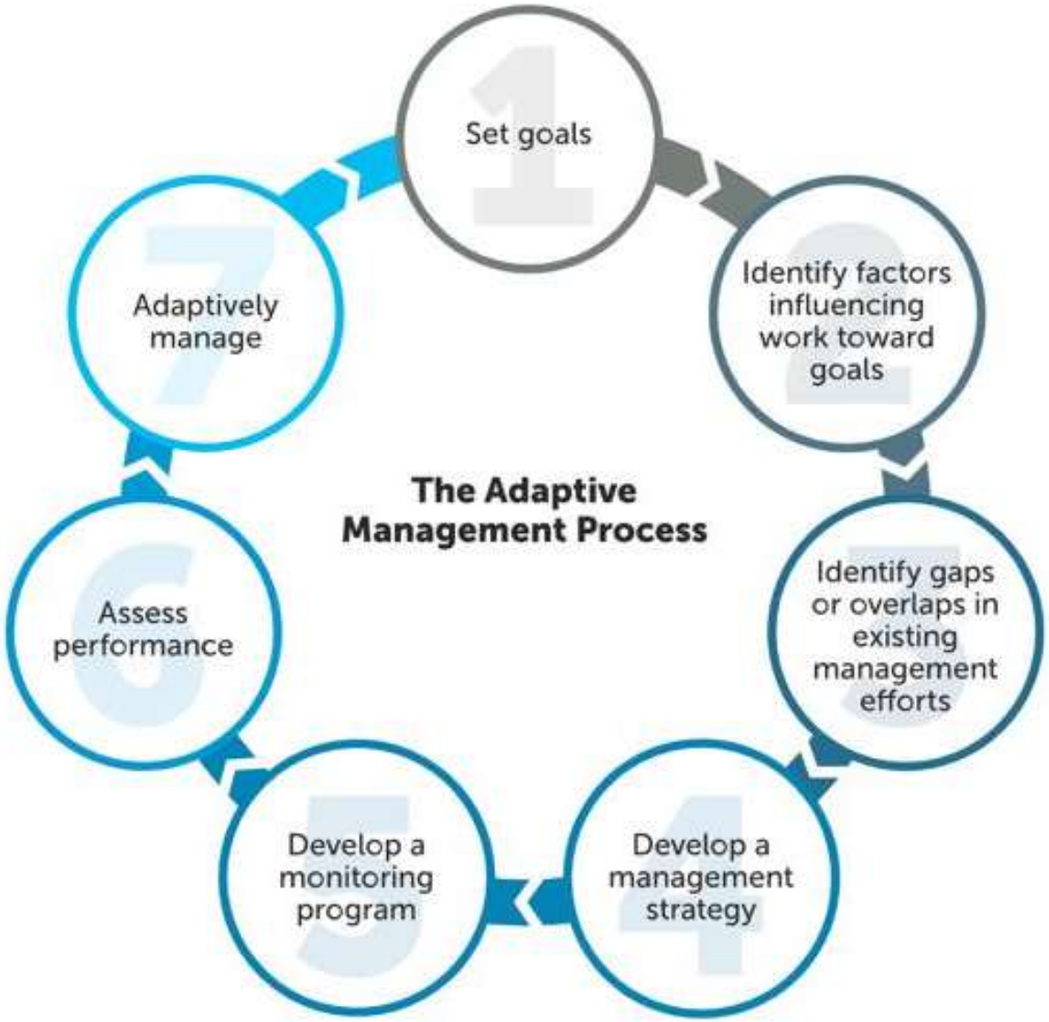
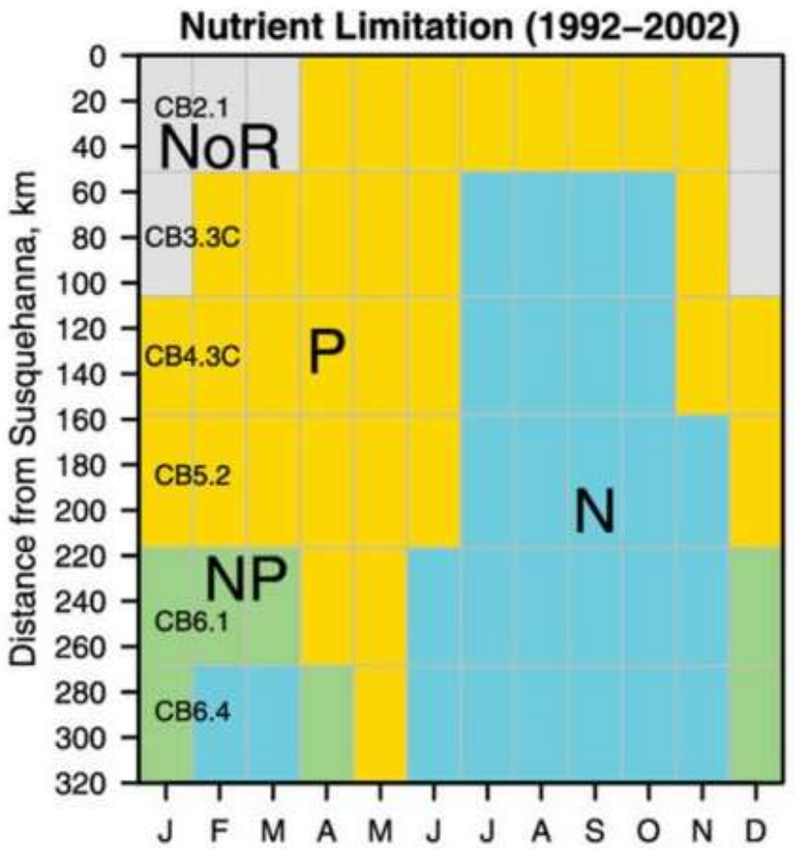
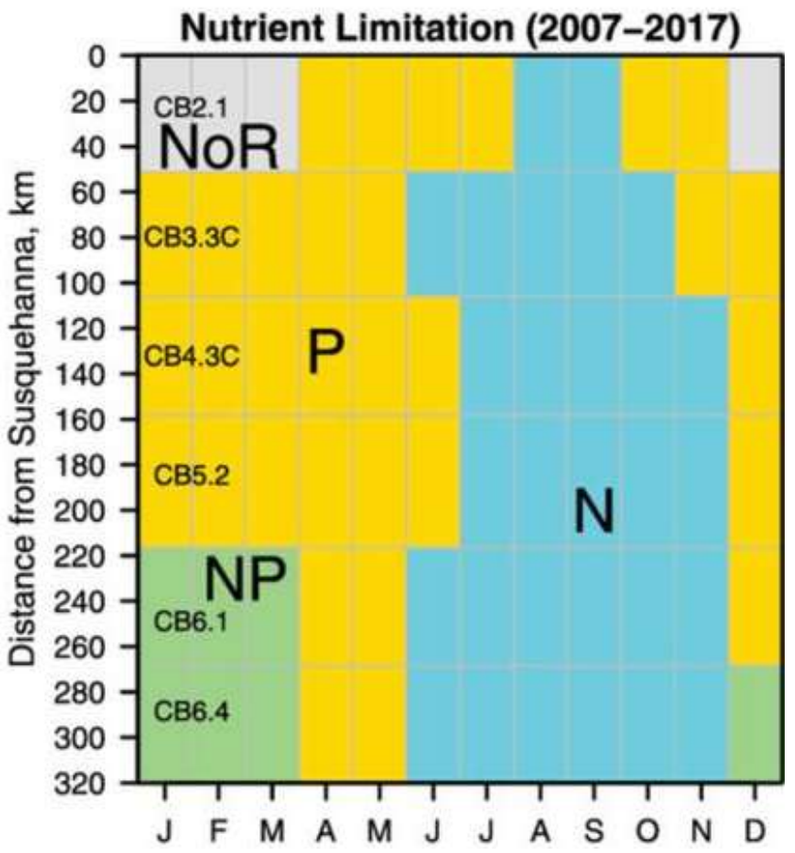
CENTER FOR ENVIRONMENTAL SCIENCE

Adaptive management in Chesapeake Bay



Changes in nutrient limitation in phytoplankton bioassays noted





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Adaptive science: Follow up on analyses to test hypothesis that nutrient limitation is responding to nutrient reductions

GRANT OPPORTUNITY

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Chesapeake Bay Program Office Fiscal Year 2023 Request for Applications for: Chesapeake Bay Tidal Water Nutrient Limitation Assessment

Type: Posted • Opportunity: EPA-I-R3-CBP-23-04

Description | Overview | Eligibility | Timing | Sizing | Contacts | Documents 1 | Grants

Applicants 8 | Similar 6

DESCRIPTION

EPA seeks to support one recipient to conduct a nutrient limitation assessment (nitrogen and phosphorus limitation) on tidal water samples from the surface waters of the mainstem Chesapeake Bay and select major tributaries over a two-year period.

Nick DiPasquale (1951-2020)