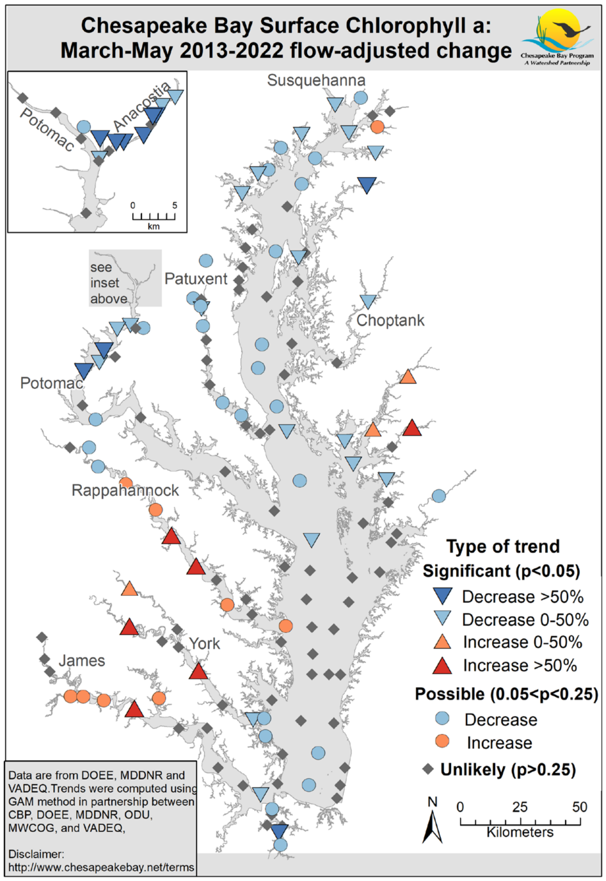
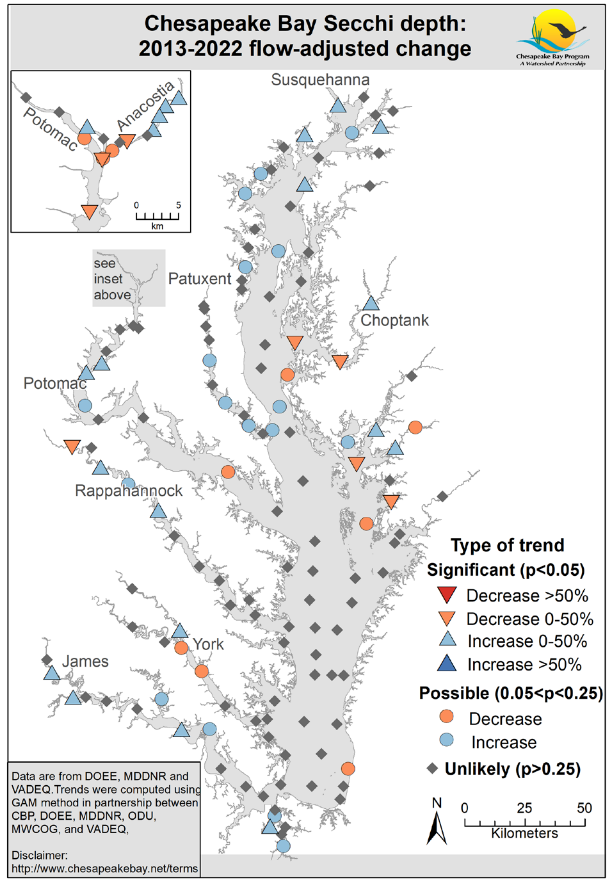
High Level Summary of Tidal Trends with Focus on DC for the 2023 EC Meeting

- Starting with the 2021 Tidal Trends results, new datasets for the Tidal Fresh Potomac and Anacostia Rivers have been integrated into the bay-wide water quality trends maps produced by the Chesapeake Bay Program Integrated Trends Analysis Team (ITAT), which is composed of analysts from jurisdictional and academic partners.
- This work was only possible thanks to collaboration with the District of Columbia Department of Energy and the Environment (DOEE) and Metropolitan Washington Council of Governments (COG), which provided, prepared, and analyzed the data.
- These data are sufficient to provide trends for the following water quality parameters:
    - Secchi Depth (an indicator of water clarity) – short and long term, observed and flow adjusted
    - Total Suspended Solids (TSS) – short and long term, observed and flow adjusted
    - Chlorophyll *a* (an indicator of algae) – spring and summer, short term observed and flow adjusted
    - Surface Dissolved Oxygen – summer, short and long term, observed and flow adjusted
- ITAT was unable to include total or dissolved nitrogen and phosphorous trends because there was not sufficient data past 2005 for either nutrient. We strongly encourage continuing and enhancing the DC water quality monitoring so the CBP may include nitrogen and phosphorus in future Bay-wide assessments. These parameters are crucial to better understand if policy and management implications are working to reduce nutrients to the Bay and inform future decisions.

Select tidal trend maps for last 10 years including Washington D.C., Maryland, and Virginia stations:


Chesapeake Bay Surface Chlorophyll a:
March-May 2013-2022 flow-adjusted change
Susquehanna
Potomac
Anacostia
see inset above
Patuxent
Choptank
Potomac
Rappahannock
York
James
Type of trend
Significant (p<0.05)
Decrease >50%
Decrease 0-50%
Increase 0-50%
Increase >50%
Possible (0.05<p<0.25)
Decrease
Increase
Unlikely (p>0.25)
0 25 50 Kilometers
Data are from DOEE, MDDNR and VADEQ.Trends were computed using GAM method in partnership between CBP, DOEE, MDDNR, ODU, MWCOG, and VADEQ,
Disclaimer: http://www.chesapeakebay.net/terms


Chesapeake Bay Secchi depth:
2013-2022 flow-adjusted change
Susquehanna
Potomac
Anacostia
see inset above
Patuxent
Choptank
Potomac
Rappahannock
York
James
Type of trend
Significant (p<0.05)
Decrease >50%
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Tidal Water Quality Change: 2022 results

Maryland Department of Natural Resources (MDDNR), Virginia Department of Environmental Quality (VADEQ), the District of Columbia, and others have coordinated to sample water quality on a bi-monthly or monthly basis at more than 130 stations located throughout the Chesapeake Bay mainstem and the tidal portions of numerous tributaries on the western and eastern shores since the mid-1980s. Scientists evaluate short- and long-term changes, or trends, in nitrogen, phosphorus, dissolved oxygen (DO), Secchi depth (a measure of clarity), chlorophyll *a*, and other constituents using a Generalized Additive Modeling (GAM) approach.

The approach includes selecting a GAM structure to describe nonlinear seasonally-varying changes over time, incorporation of hydrologic variability via either river flow or salinity, the use of an intervention to accommodate method or laboratory changes suspected to impact data values, and representation of data reported less than or between method detection limit(s) (Murphy et al, 2019, 2021).

Changes in observed conditions (i.e., the conditions experienced by the estuary's living resources) are used to evaluate incremental progress towards improved habitats and attainment of water quality standards. Changes in flow-adjusted conditions account for year-to-year variations in streamflow or salinity and can be used for understanding the influence of watershed management actions on the estuary. The percent of stations improving, degrading, and showing no change using data collected through 2022 are summarized in Table 1. Short-term trends are for the last 10 years, and long-term trends are from the mid-1980s to 2022.

Overall, nutrient concentrations have improved at the majority of stations over the long-term. Secchi depth, chlorophyll *a,* and DO improved at fewer stations than nutrient concentrations over the long-term, however the number of stations with degrading conditions have decreased over the short-term. Freshwater flow variability does impact these trends, but annual mean freshwater flows in 2021 and 2022 were close to average when compared to annual flows since 1937 (USGS, 2022).

Table 1. *The percent of stations improving, degrading, and showing no change using data collected through 2022 for nutrients, dissolved oxygen, chlorophyll a, and Secchi depth*

	Observed Conditions			**Flow-adjusted Conditions**		
Water Quality Variable	**Improving**	**No Change**	**Degrading**	**Improving**	**No Change**	**Degrading**
Short-term Trend (2013-14 to 2021-22)						
Dissolved Oxygen (summer, bottom layer)	11%	66%	23%	7%	69%	24%
Secchi depth (annual)	27%	62%	11%	26%	62%	12%
Chlorophyll *a* (spring, surface layer)	27%	62%	11%	36%	51%	13%
Total Nitrogen (annual, surface layer)	45%	49%	6%	49%	41%	10%
Total Phosphorus (annual, surface layer)	20%	59%	21%	26%	55%	19%
Long-term Trend (Period of Record)						
Dissolved Oxygen (summer, bottom layer)	30%	41%	28%	19%	48%	33%
Secchi depth (annual)	16%	32%	52%	20%	32%	49%
Chlorophyll *a* (spring, surface layer)	25%	38%	37%	28%	46%	26%
Total Nitrogen (annual, surface layer)	85%	12%	3%	86%	12%	3%
Total Phosphorus (annual, surface layer)	80%	9%	11%	78%	14%	8%

Dissolved Oxygen

For this summary, we describe both long- and short-term trend results, with short-term values in parentheses following long-term.

Summer bottom DO conditions and trends vary widely across the tidal waters due to differences in water depth impacting vertical mixing. Observed summer bottom DO over the long- (short-) term period show 30% (11%) of stations with improving conditions, 28% (23%) with degrading conditions, and 41% (66%) with no change.

More degrading DO conditions occur in the tributaries, while some notable long-term improvements are occurring along the deep mainstem channel.

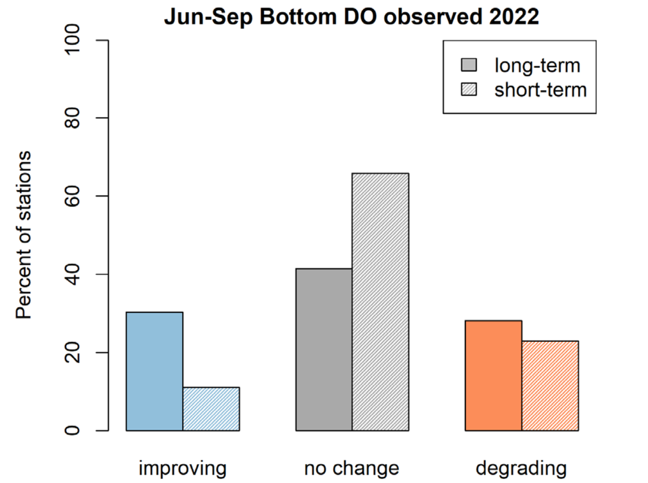

Figure 1. Percent of stations with improving, degrading, and no change for dissolved oxygen in the bottom layer during the summer season for long- and short-term periods.

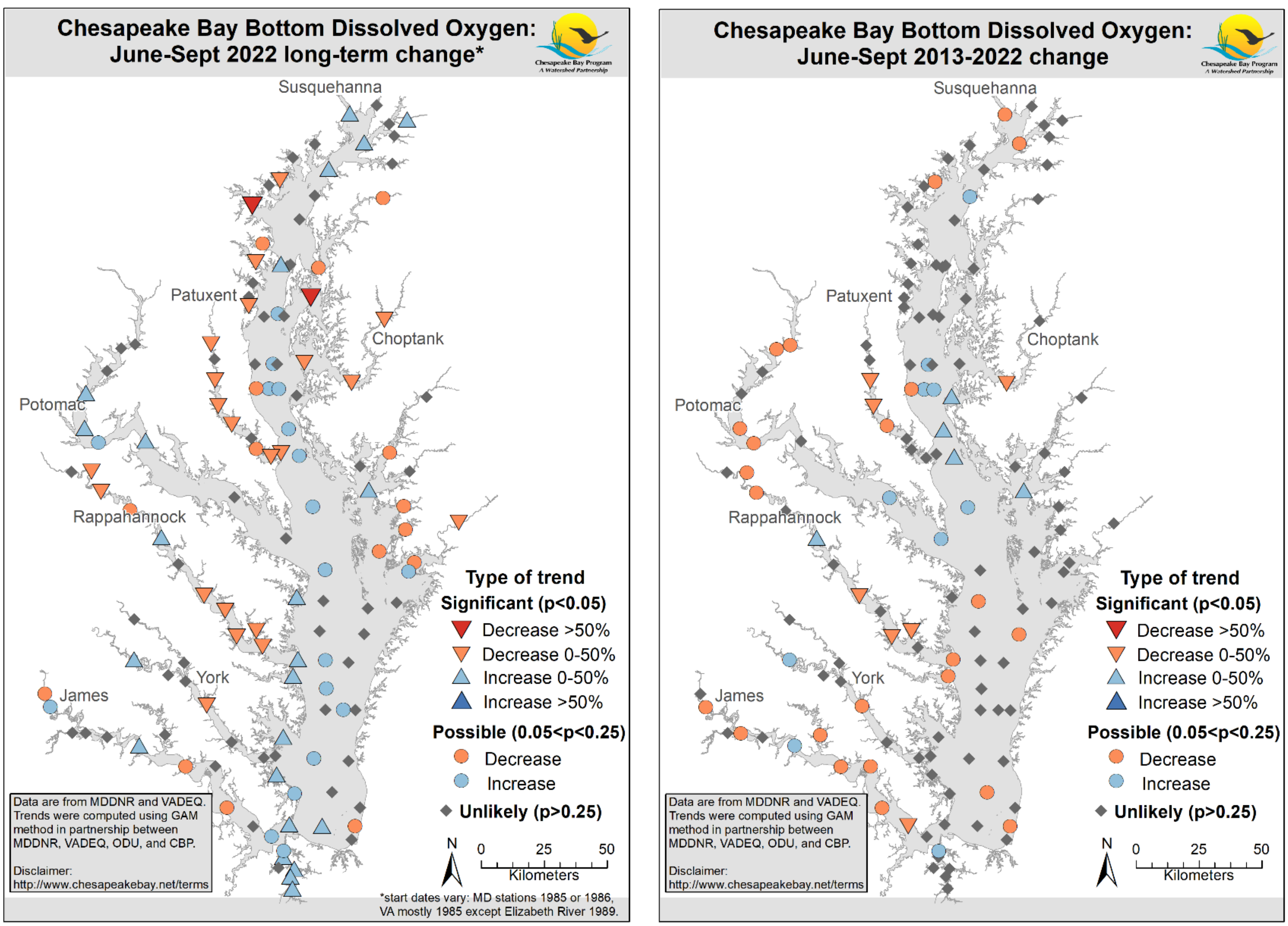

Figure 2. Changes in observed dissolved oxygen in the bottom layer during the summer season for long- (left panel) and short-term (right panel) periods.

Secchi Depth

Trends in flow-adjusted annual Secchi depth have notably changed from the long-term period to short-term. Flow-adjusted Secchi depth over the long- (short-) term show 20% (26%) of stations have improving conditions, 49% (12%) have degrading conditions, and 32% (62%) have no change.

Secchi trends at tidal Washington D.C. stations are included for the second time this year (see inset in Figure 4) and include mostly long-term improvements with mixed trends in the short-term. Bay-wide, long-term degradation in flow-adjusted Secchi depth is notable at the majority of stations. Fewer degrading trends persist over the short-term period.

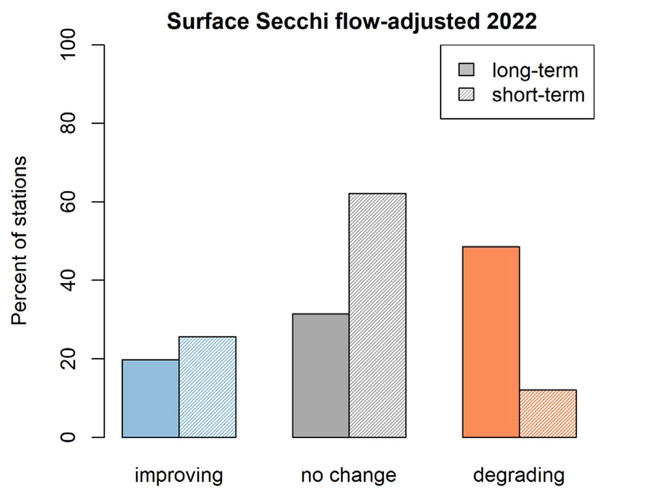

***Figure 3**. Percent of stations with improving, degrading, and no change for flow-adjusted annual Secchi depth for long- and short-term periods.*

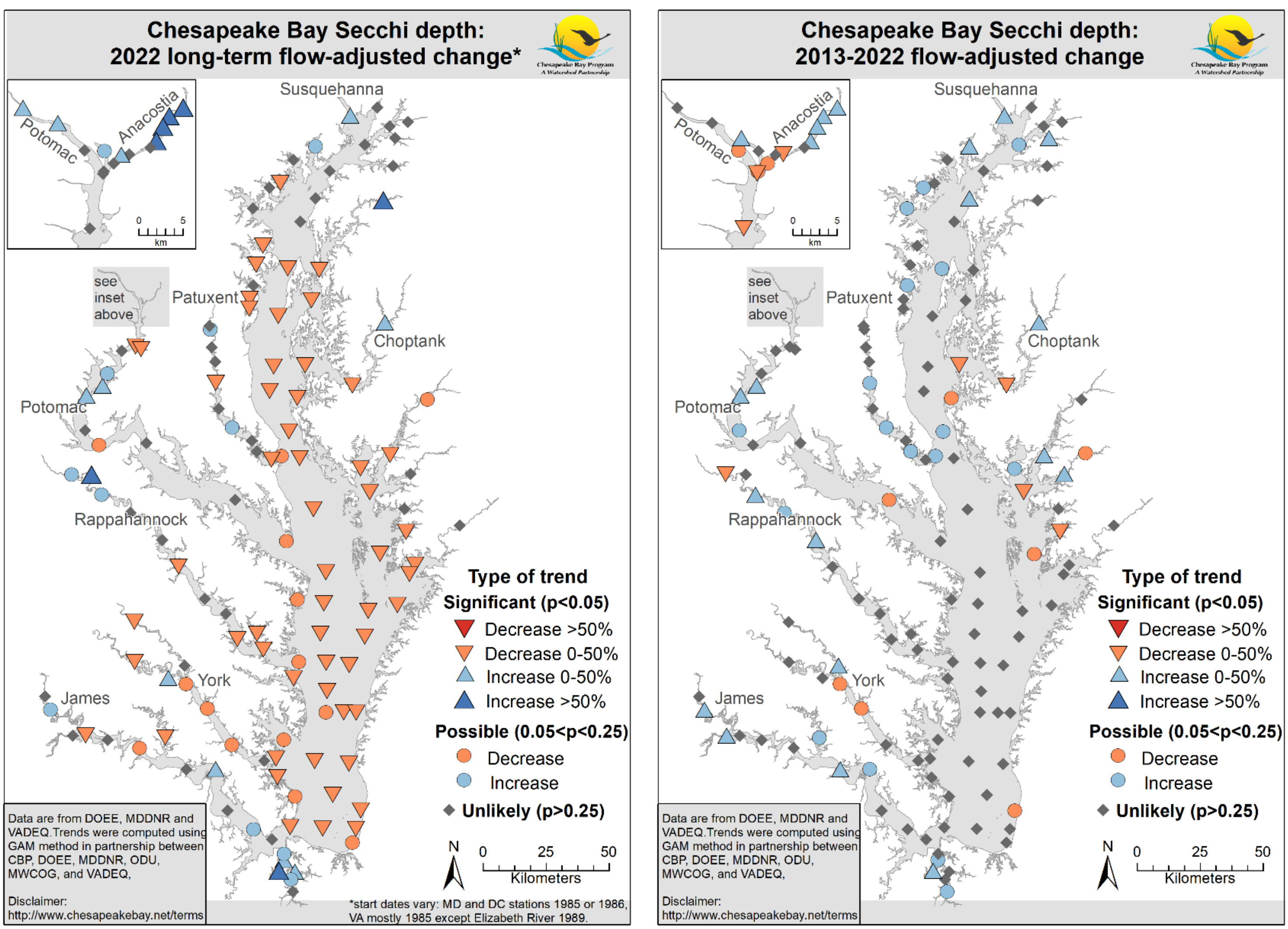

Figure 4. Changes in flow-adjusted annual Secchi depth for long- (left panel) and short-term (right panel) periods.

Chlorophyll *a*

Changes in spring surface chlorophyll *a* vary by region. Overall, flow-adjusted spring chlorophyll *a* in the surface layer over the long- (short-) term show 28% (36%) of stations have improving conditions, 26% (13%) have degrading conditions, and 46% (51%) have no change.

Long-term trends are mixed spatially for spring chlorophyll *a* with approximately the same percent of stations improving and degrading. Over the short-term, fewer stations have degrading chlorophyll *a*. Short-term trends were computed for the Washington DC stations and show mostly improving spring chlorophyll *a*.

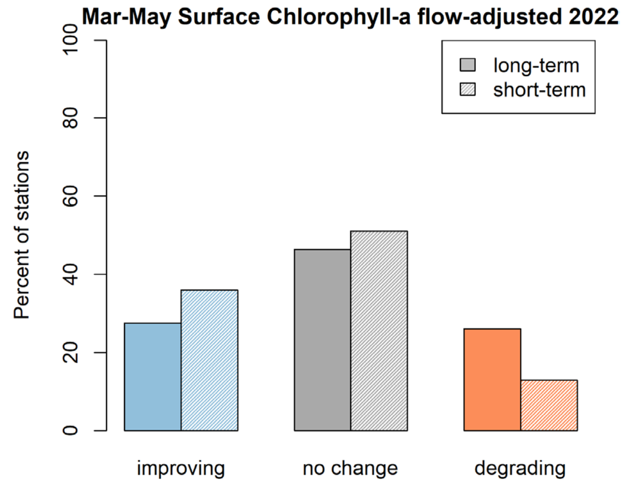

Figure 5. *Percent of stations with improving, degrading, and no change in flow-adjusted spring chlorophyll a in the surface layer for long- and short-term periods.*

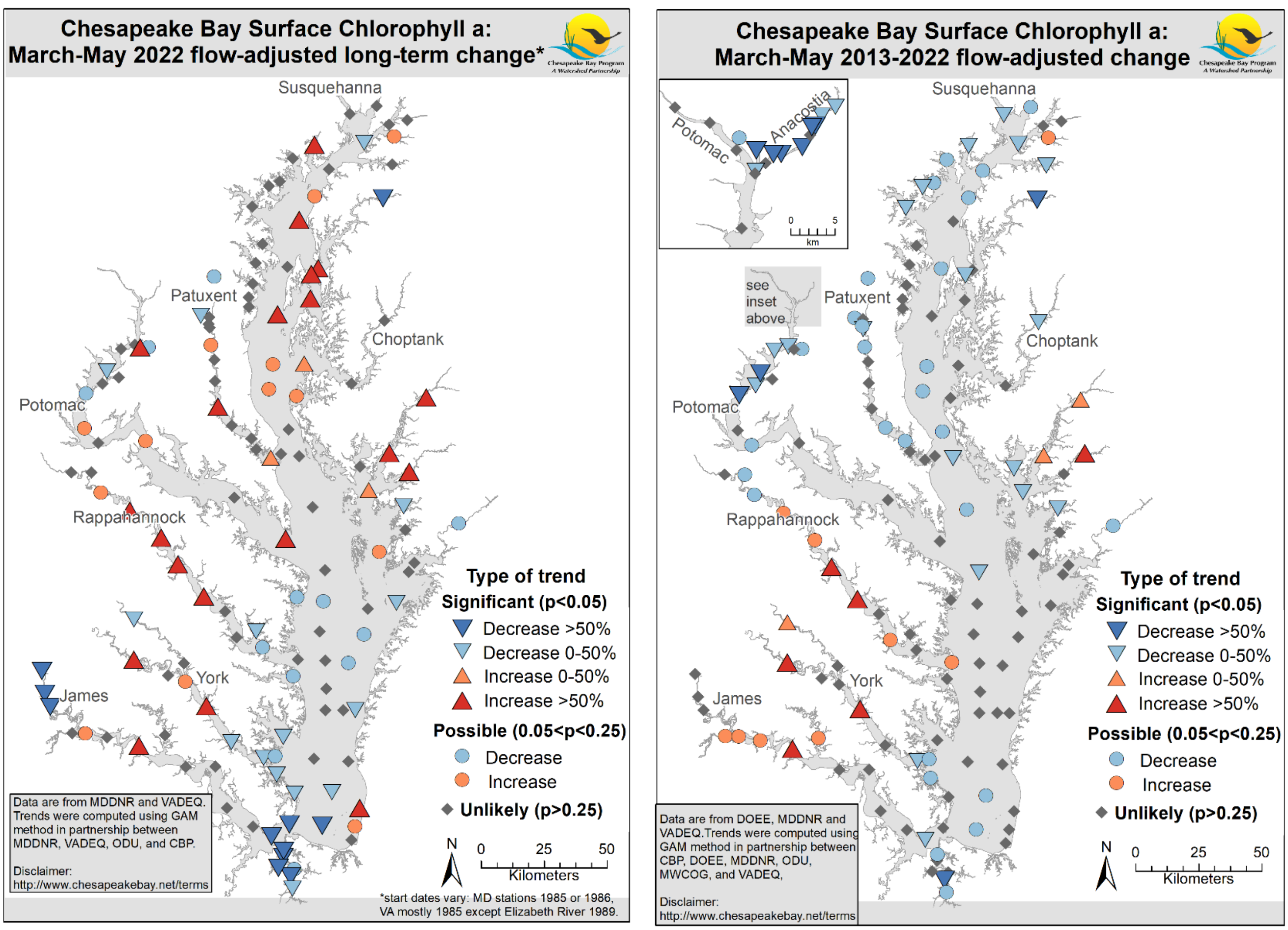

Figure 6. *Changes in flow-adjusted spring chlorophyll a in the surface layer for long- (left panel) and short-term (right panel) periods.*

Total Nitrogen

Both total nutrients have improved bay-wide over the long-term. Flow-adjusted surface total nitrogen over the long- (short-) term show 86% (49%) of stations have improving conditions, 3% (10%) have degrading conditions, and 12% (41%) have no change.

Long-term surface total nitrogen concentrations are clearly decreasing throughout most of the Chesapeake Bay tidal waters. Many of these trends persist over the short term as well, although more stations show stable or degrading conditions over the short-term, especially in several tributaries.

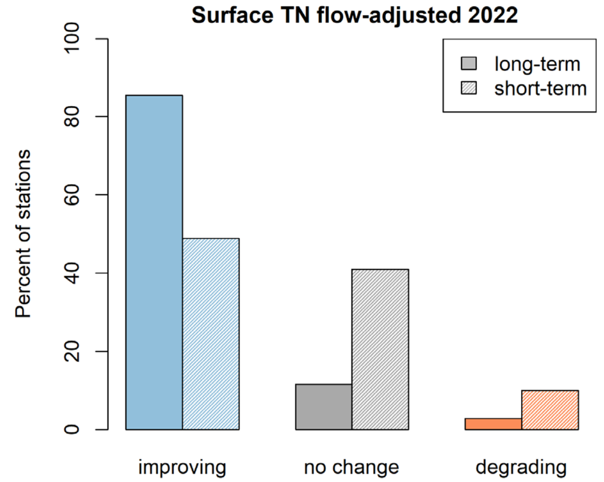

Figure 7. *Percent of stations with improving, degrading, and no change in flow-adjusted annual total nitrogen in the surface layer for long- and short-term periods.*

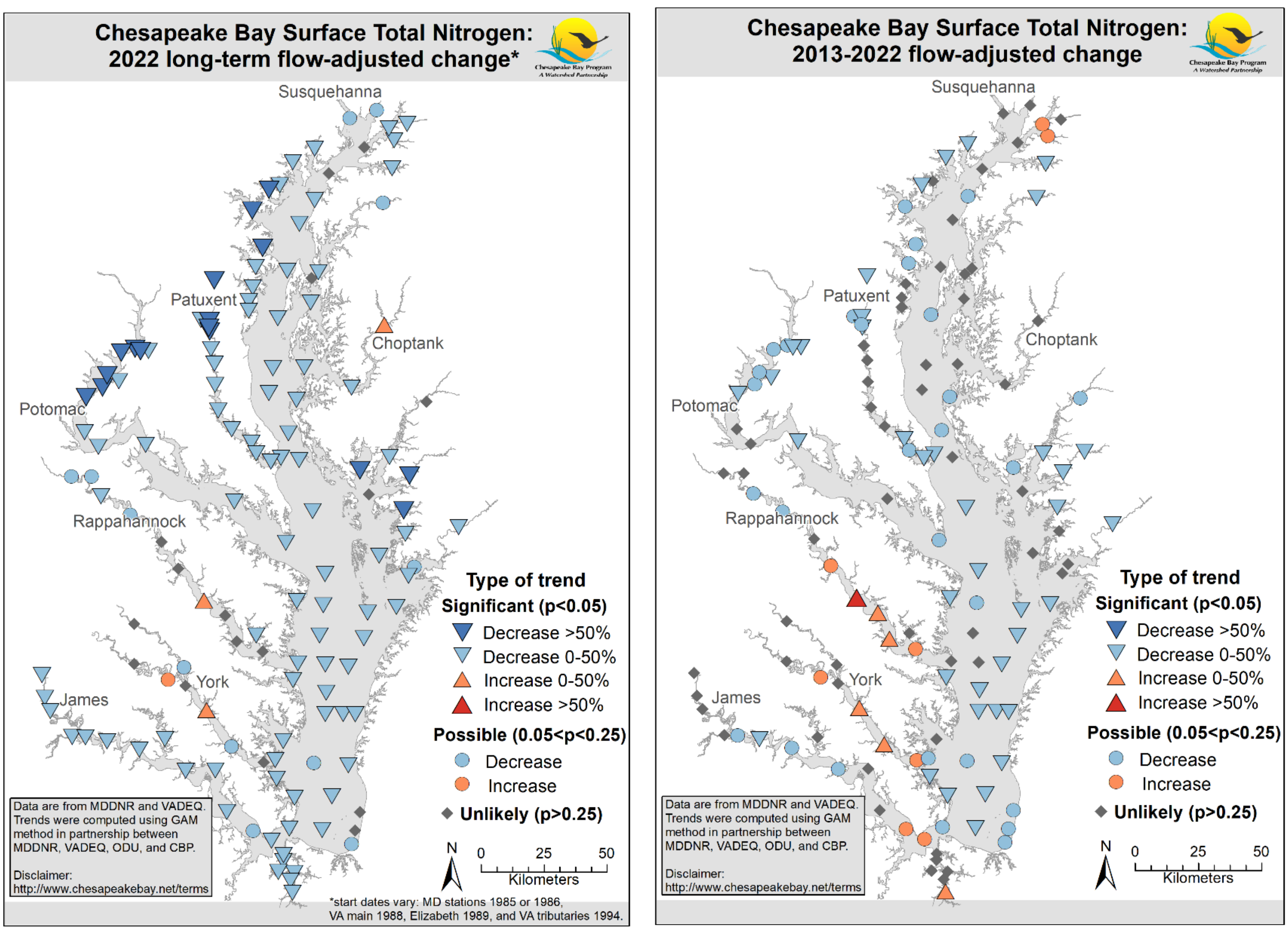

Figure 8. *Changes in flow-adjusted annual total nitrogen in the surface layer for long- (left panel) and short-term (right panel) periods.*

Total Phosphorus

For flow-adjusted surface total phosphorus, long- (short-) term trends show that 78% (26%) of stations have improving conditions, 8% (19%) have degrading conditions, and 14% (55%) have no change.

Long-term flow adjusted annual total phosphorus in the surface layer is improving at most stations with exceptions in several tributaries. Like for total nitrogen, more stations show stable or degrading conditions over the short-term.

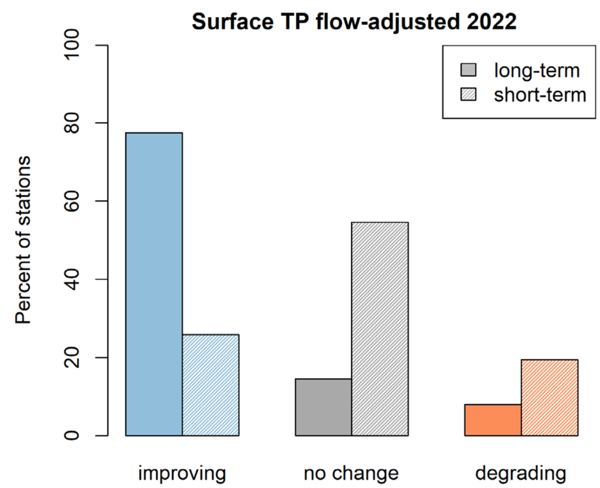

Figure 9. *Percent of stations with improving, degrading, and no change in flow-adjusted annual total phosphorus in the surface layer for long- and short-term periods.*

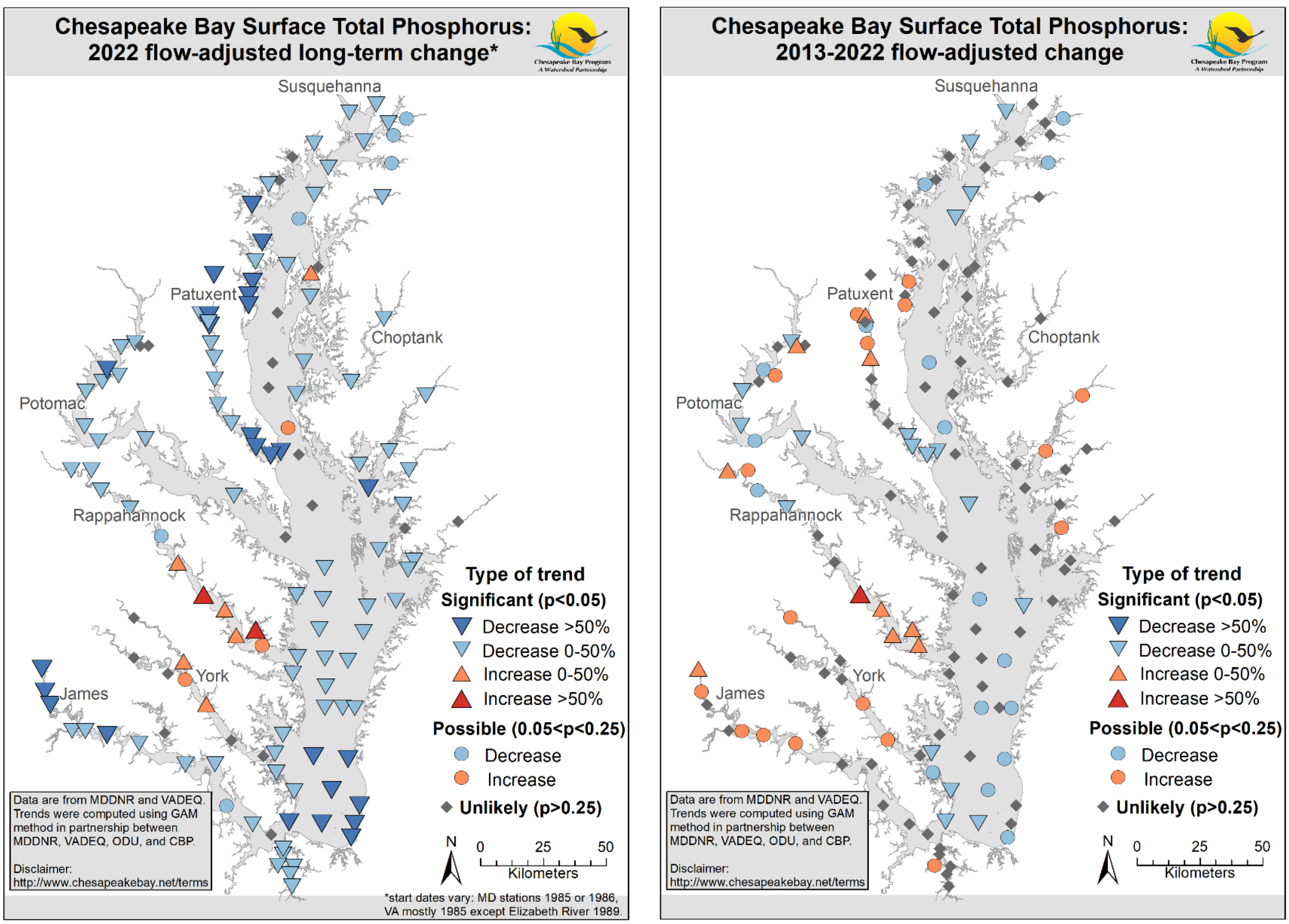

Figure 10. *Changes in flow-adjusted annual total phosphorus in the surface layer for long- (left panel) and short-term (right panel) periods.*

References

USGS. 2023. https://www.usgs.gov/centers/chesapeake-bay-activities/science/freshwater-flow-chesapeake-bay

Murphy, R, E. Perry, J. Keisman, J. Harcum, and E. Leppo. 2021. baytrends: Long Term Water Quality Trend Analysis. R package version 2.0.5. https://cran.r-project.org/web/packages/baytrends/index.html

Murphy, R.R., E. Perry, J. Harcum, and J. Keisman. 2019. A generalized additive model approach to evaluating water quality: Chesapeake Bay case study. Environmental Modeling and Software 118 (August 2019): 1-13.

2023 STATE OF THE ANACOSTIA RIVER REPORT CARD

Anacostia Watershed Society

Thriving Wildlife, Failing Grade

Despite visible signs of an improving river habitat, including the celebrated return of otters, the Anacostia River received a failing grade on the 2023 State of the River Report Card, the third failing grade in six years. Many indicators of water quality continue to improve, but these are outweighed by two significant factors in river health - submerged aquatic vegetation, and the presence of fecal bacteria from human waste. These two critical indicators have continued to worsen and the exact causes remain unclear, though increased storm events as a result of changing climate are a likely factor. We can remain positive that the long-term trends from 1989 indicate steady improvement, but this year's grade is still a rallying cry for DC's Department of Energy and Environment to step up efforts to address barriers to a swimmable, fishable Anacostia River.

2023 ANACOSTIA RIVER REPORT CARD

		SCORE	GRADE	MULTI-YEAR TREND
Water Quality Indicators (Quantitative)	Dissolved Oxygen	55%	F	! (Needs attention)
	Fecal Bacteria	53%	F	↑ (Improving)
	Water Clarity	50%	F	↑ (Improving)
	Chlorophyll *a*	82%	B-	↑ (Improving)
	Submerged Aquatic Vegetation	16%	F	↑ (Improving)
	Stormwater Runoff Volume	34%	F	= (Static)
Remediation Indicators (Qualitative)	Toxics Remediation	62%	D-	↑ (Improving)
	Trash Reduction	66%	D	↑ (Improving)
	OVERALL GRADE	**52**	**F**	↑ (Improving)

LEGEND: ↑ IMPROVING; ! NEEDS ATTENTION; = STATIC

What We Track

The Anacostia River saw a sharp loss in **Submerged Aquatic Vegetation**, which has driven the river's passing grade in recent years.These plants require light to thrive and are essential habitat for young fish and other aquatic life. A score of 100% means the Anacostia River has at least 20 acres of SAV beds.

Dissolved Oxygen is critical for the survival of aquatic life and ecosystem sustainability, a score of 100% means that the water is equal to or more than 5mg/L of oxygen all the time. In 2023, the long term trend indicates that immediate attention is needed.

Water Clarity is a measure of light penetrating the water column. This affects the health of aquatic grasses. A score of 100% means that the water is, on average, clear enough to see through at least 4.25 feet.

Chlorophyll a is the measure of microalgae biomass; this can impact water clarity and dissolved oxygen levels, and indicates the amount of nutrients like phosphorus and nitrogen. A score of 100% means that the body of water has only the appropriate amount of microalgae biomass.

Stormwater Runoff is the fastest growing source of pollution in the Chesapeake Bay and flushes trash and toxics from paved areas and erodes stream banks, filling the river with sediment.

The Challenges

Climate Change can set back decades-long efforts to improve water quality. More frequent and intense rain events and sea level rise can increase pollution levels, reduce aquatic vegetation, and aggravate stormwater run-off.

The score for **Fecal Bacteria** declined slightly to 53% from 55% last year. A score of 100% means that fecal bacteria levels are low enough that the river is safe for swimming at all times. This contamination is caused by sewage discharges and leaks, as well as from pet and wildlife waste. Fecal bacteria levels remain stubbornly high in parts of the Anacostia River, despite the dramatic reduction in sewer overflows with the completion of DC Water's Anacostia River tunnel.

Next Steps

Conservation and management decisions from the headwaters in Montgomery and Prince George's counties to the mouth of the Anacostia River in DC must aim to make the watershed resilient to the unavoidable effects of climate change. DOEE, DC Water, and WSSC must redouble their efforts to identify and mitigate continuing sources of fecal pollution.

Full report available online at: www.anacostiaws.org/state-of-the-river-report-card