Progress toward attainment of Chesapeake Bay water-quality standards

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October 12, 2021

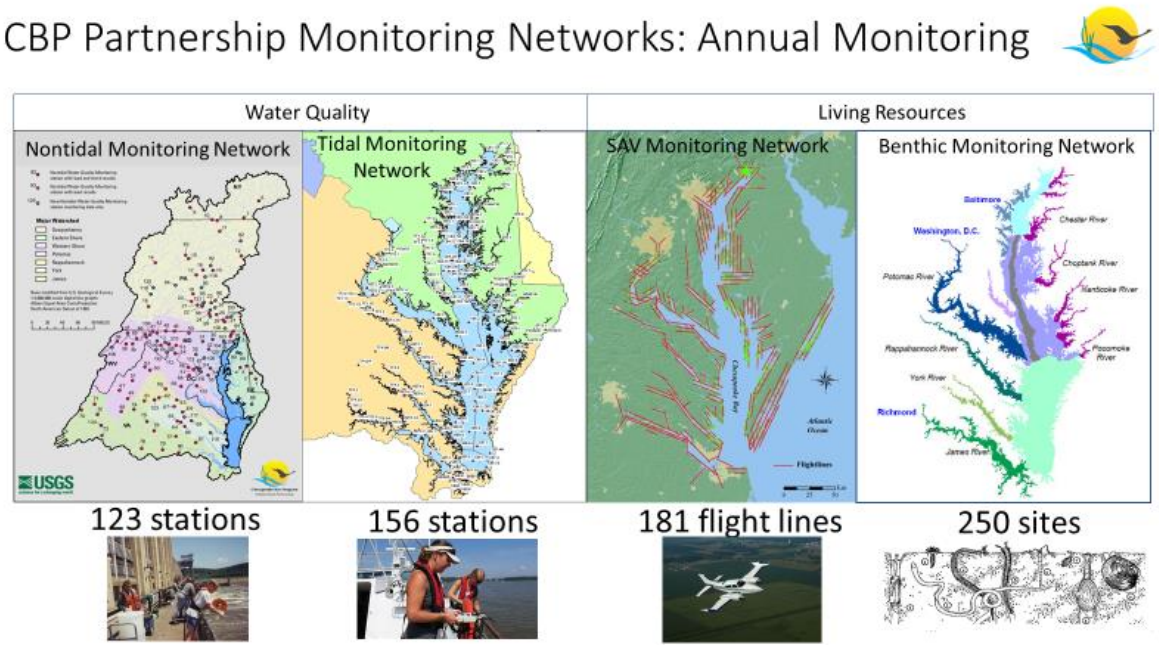
We are looking for your feedback.

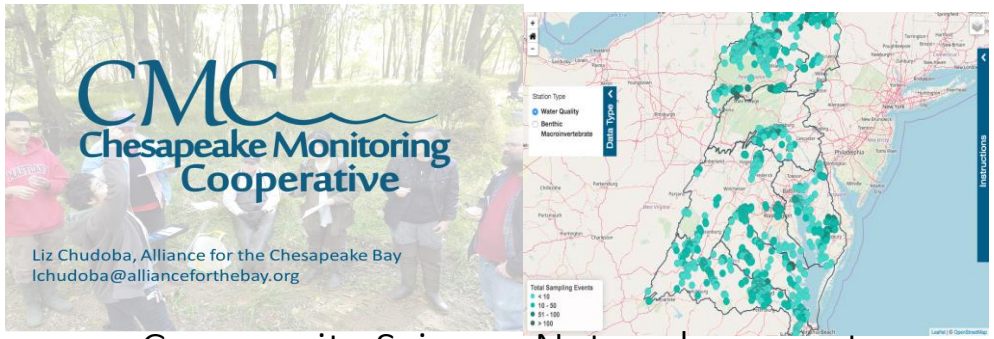
1. What are some of the technical issues you'd like us to work with you on between now and 2025?
2. What are the ways you want us to work with you and communicate this information?
3. Longer term, what issues do you see after 2025 that you'll need help with?

Monitoring networks supporting assessments of watershed loads to the Bay, tidal trends, and water quality standards attainment

CBP networks: Data sources

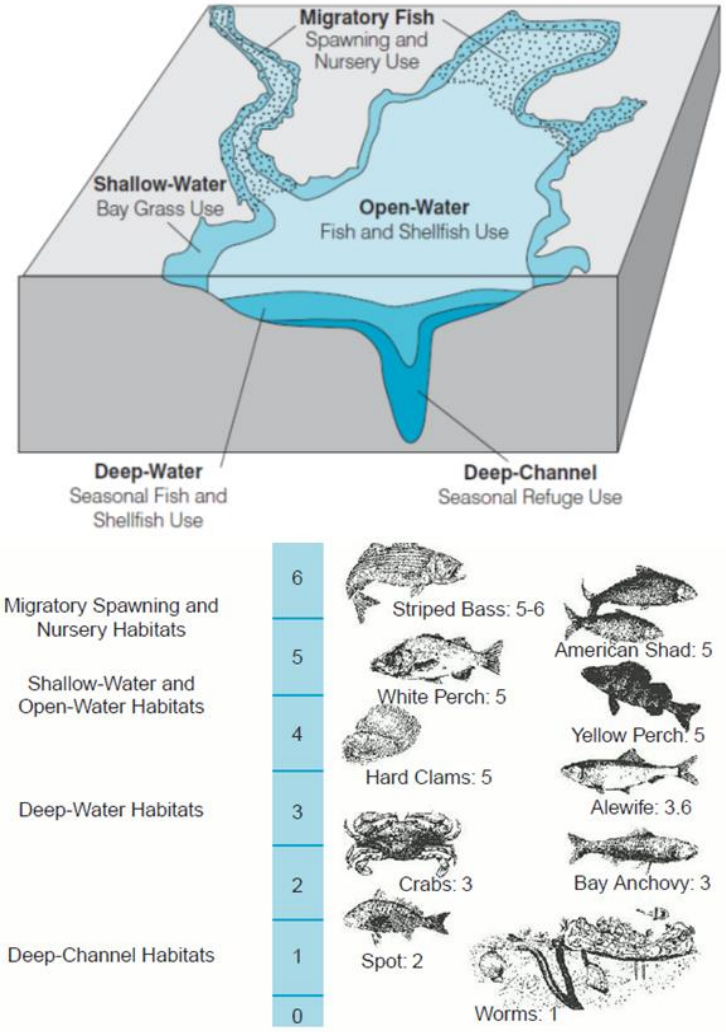
* Tidal water quality
* SAV acreage
* Community (Citizen) monitoring
* Tidal benthic organisms
* Nontidal nutrients and sediment





Community Science Network support

Water quality standards involve five designated uses (DUs)



Criteria	Designated Use	Threshold	Applicable Segments
Dissolved Oxygen	Migratory Fish Spawning & Nursery (MSN)	30-day mean, February-May	73
	Open Water (OW)	30-day mean, June-September	92
	Deep Water (DW)	30-day mean, June-September	18
	Deep Channel (DC)	Instantaneous, June-September	10
Chlorophyll-a	Open Water (OW)	Chlorophyll-a concentrations	7
SAV and/or Water Clarity	Shallow Water (SW)	Segment-specific water clarity and bay grass acreage goals	79

Note: The attainment indicator uses **a subset** of the complete accounting for the criteria to **estimate** the attainment of water quality standards (WQS).

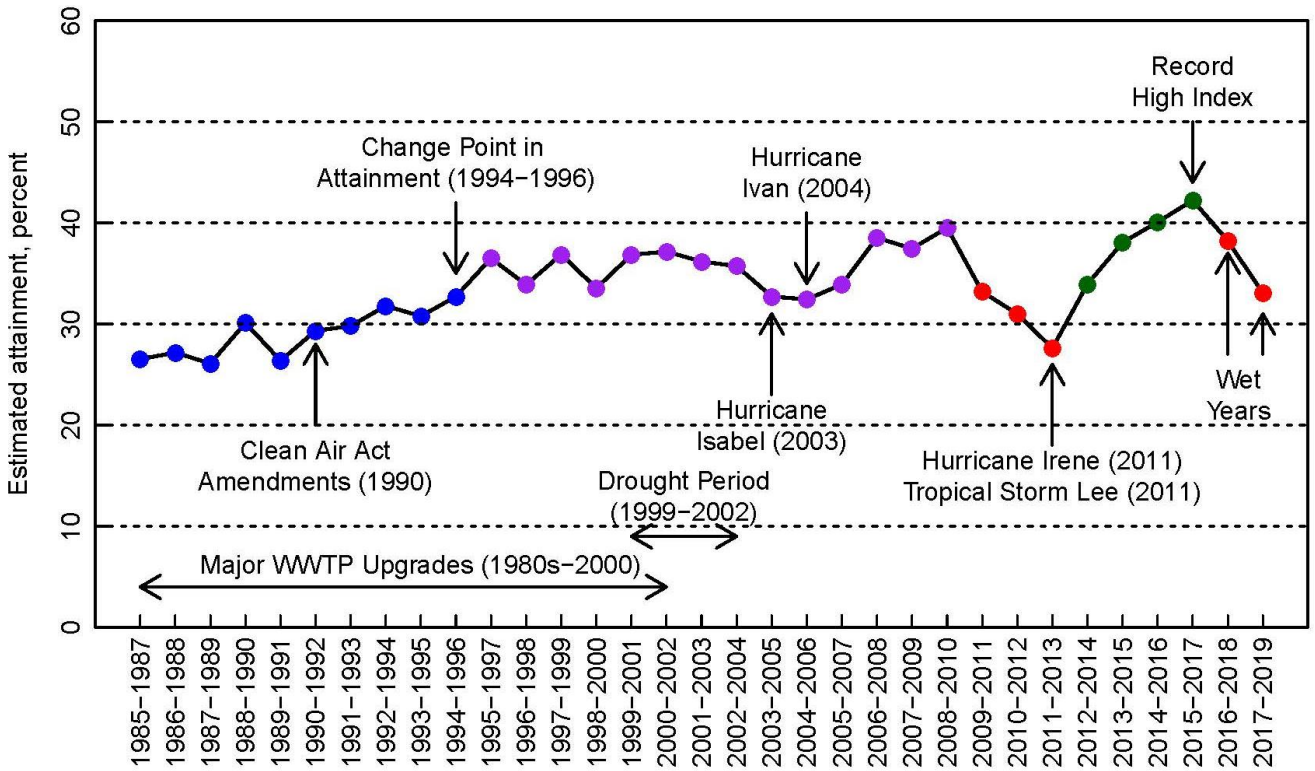
Water quality standards attainment indicator

Question:

What's the current status and long-term trend of Chesapeake Bay in terms of the estimated WQS attainment?

Answer:

- Reached its peak (42%) in 2015-2017 but dropped to 33% in 2017-2019.
- It is responsive to extreme weather events but can quickly recover afterwards.
- The indicator has a positive long-term trend ($p < 0.05$) in 1985-2019.
- However, based on the estimated trend of 0.33%/yr, it may take 180 years to close the gap and reach 100% attainment.



WQS attainment by designated use (DU)

Question:

Which designated uses (DUs) have shown improvements?

Answer:

- OW-DO, DC-DO, and SW-Clarity/SAV have all shown statistically significant, long-term improvements, which have contributed to the improvement in the overall indicator.

Designated use	Initial attainment, percent	Current attainment, percent	LT MK trend, percent/yr	p-value
Total	26.5	33.1	0.34	***
MSN-DO	64.3	65.3	-0.46	***
OW-DO	48.7	62.8	0.59	*
DW-DO	22.7	15.0	0.00	-
DC-DO	21.9	12.3	0.12	***
OW-CHLA	0.0	0.5	0.00	-
SW-Clarity/SAV	1.0	16.0	0.44	***

statistical significance: $p < 0.05$ (***), $0.05 < p < 0.1$ (*), $p > 0.1$ (-)

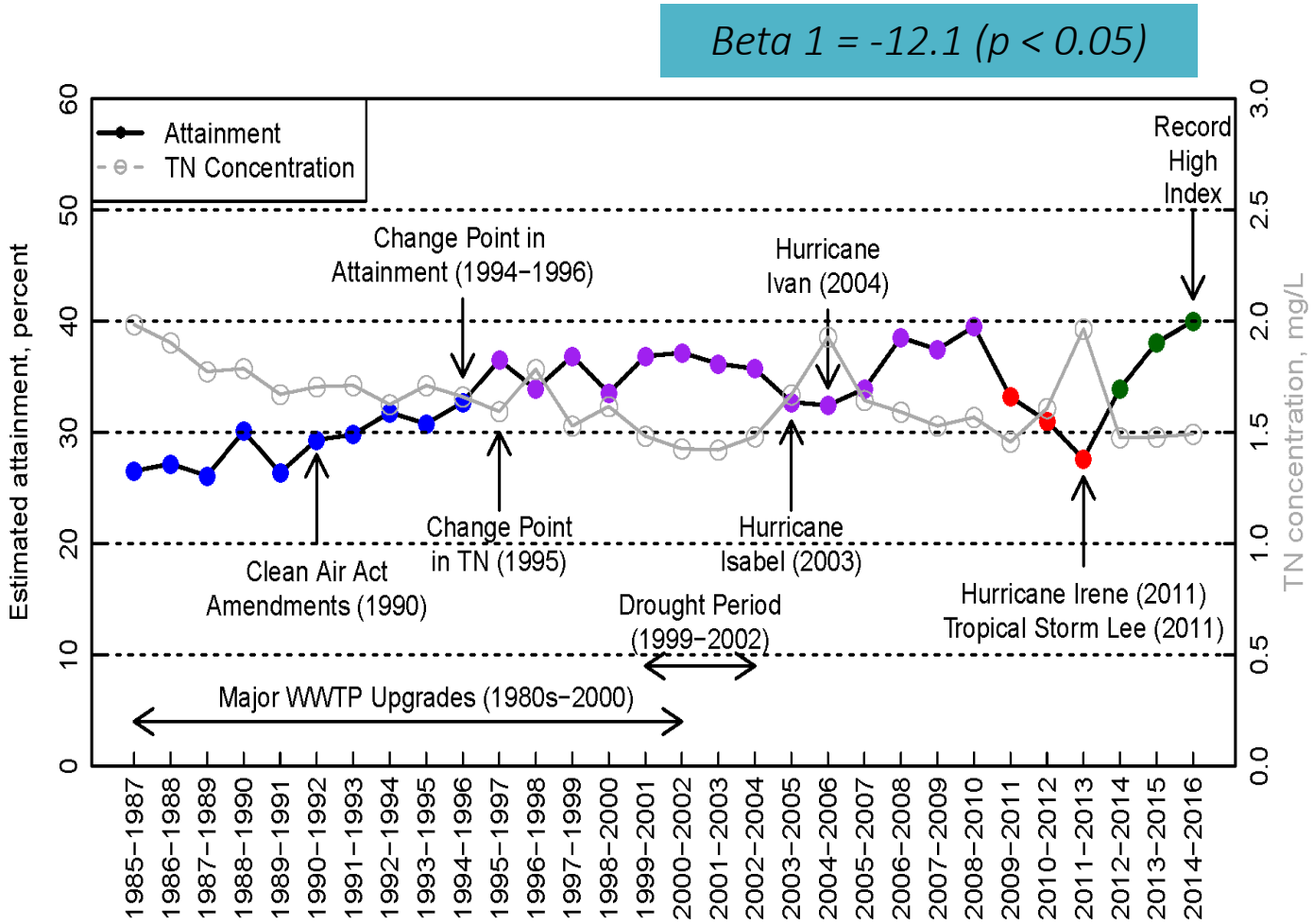
Nitrogen reduction has played a role

Question:

What has caused the long-term improvement in the overall indicator?

Answer:

- The improvement in the Baywide attainment was statistically linked to the decline of TN input from the watershed, suggesting the effectiveness of nutrient control actions.
- Additional factors (TP, flow, WTEMP, Secchi, etc.) are under investigation.



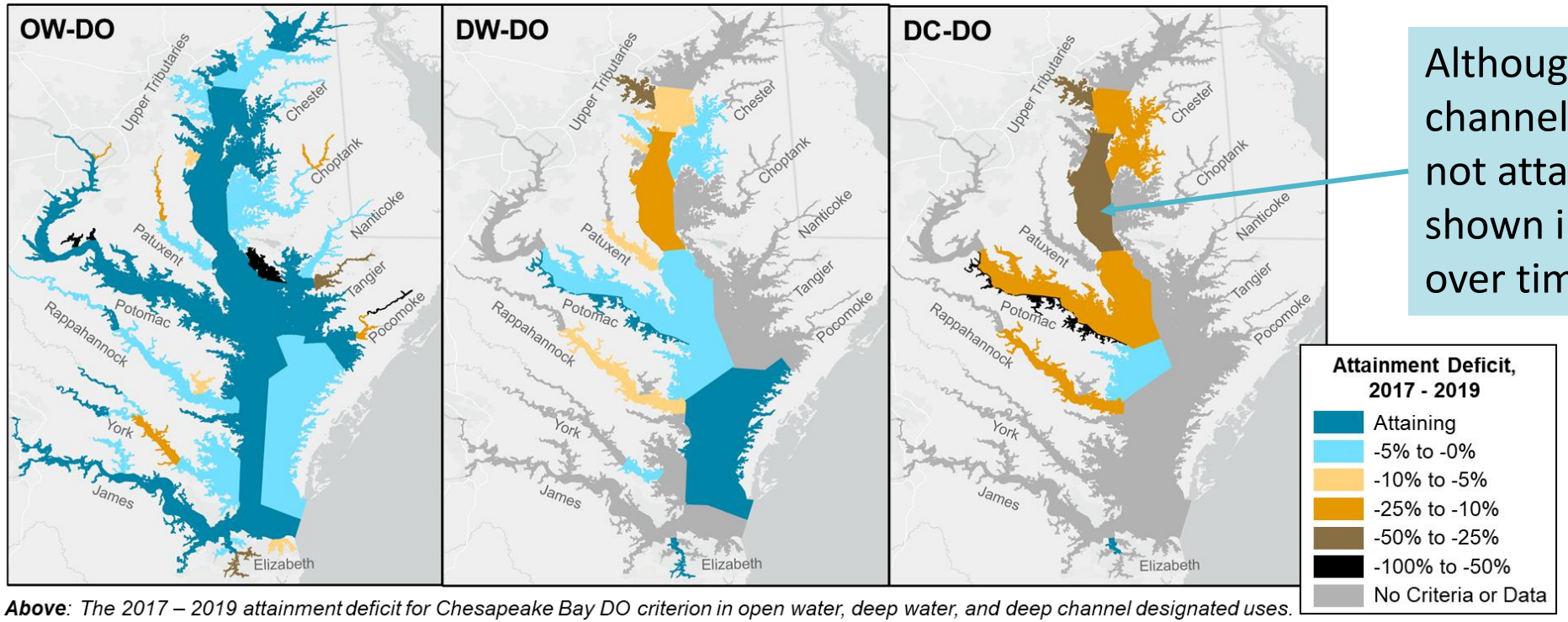
Water quality standards attainment deficit

Question:

Can additional information be extracted from the attainment assessment for specific regions?

Answer:

- Yes. We can quantify the attainment deficit for varying levels of spatial units to provide spatially explicit information: segments, designated uses, or tributaries.



Although the deep channel segments are not attaining, they have shown improvements over time.

***Above**: The 2017 – 2019 attainment deficit for Chesapeake Bay DO criterion in open water, deep water, and deep channel designated uses.*

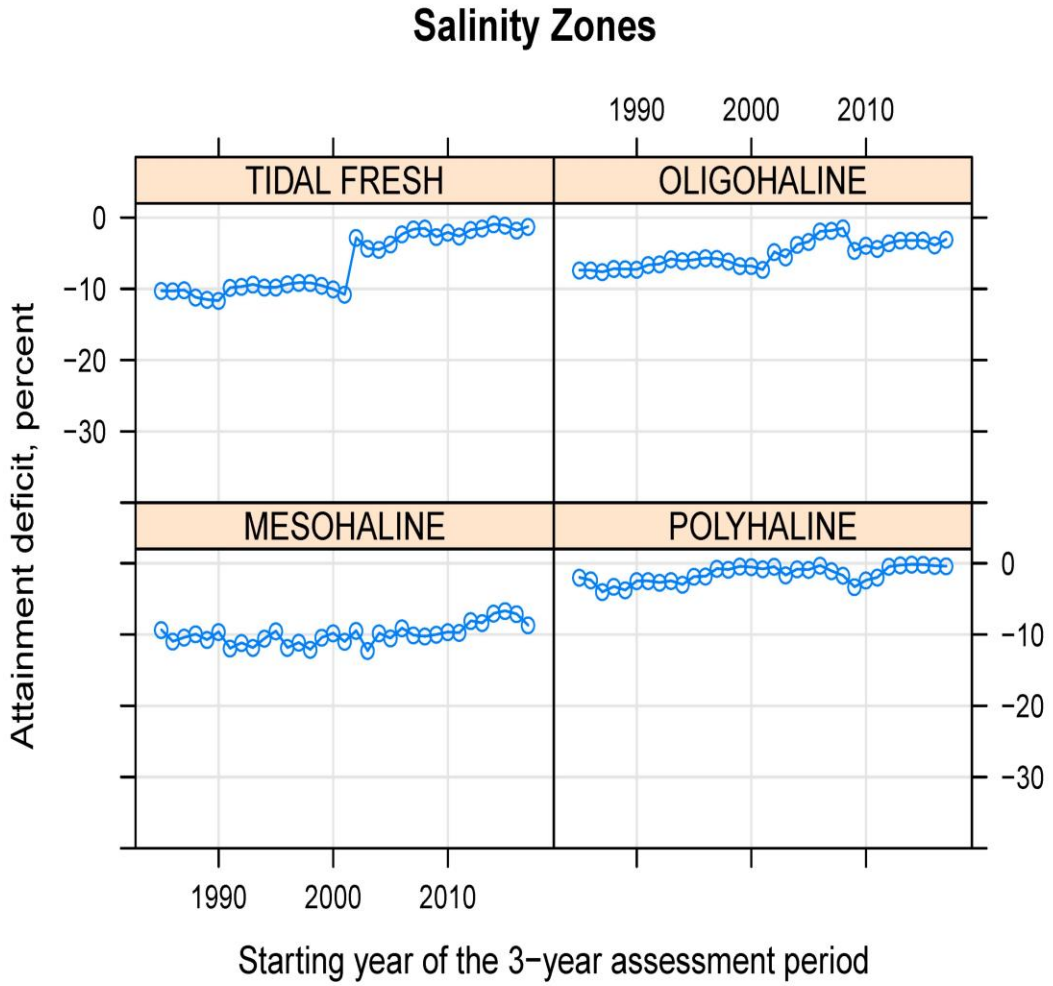
Water quality standards attainment deficit

Question:

Can additional information be extracted from the attainment assessment for specific regions?

Answer:

- The non-binary nature of attainment deficit allows it to better compare spatial conditions and assess temporal trends.
- For example, all four salinity zones, especially TF and OH, showed long-term improvements. The jump around 2001 in the tidal fresh trajectory may reflect system response to a combination of N reduction and drought.



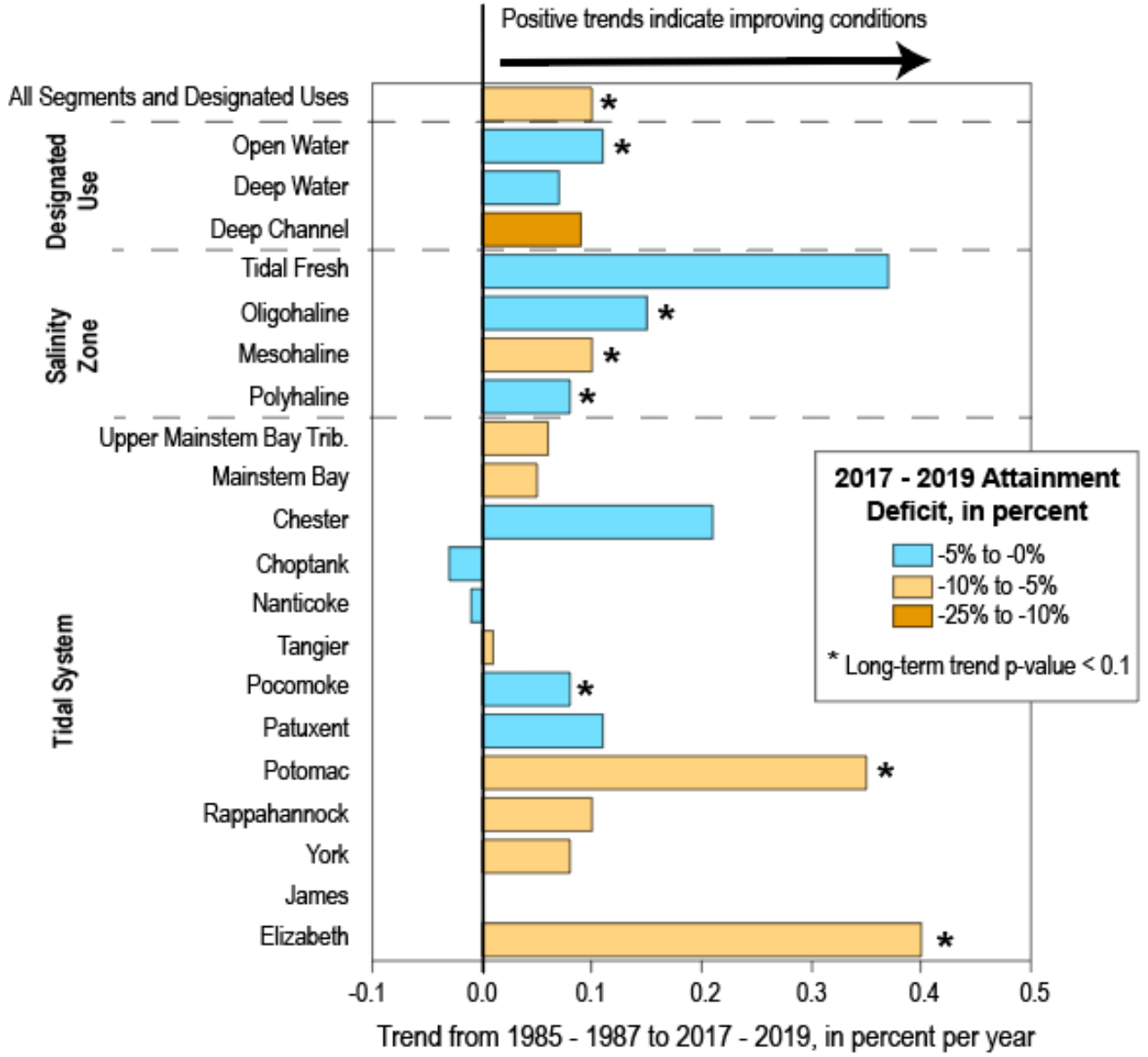
Water quality standards attainment deficit

Question:

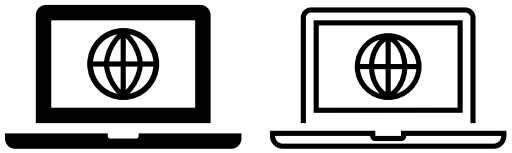
Can additional information be extracted from the attainment assessment for specific regions?

Answer:

- Most of these groups show long-term improvements, some of which are statistically significant, including Pocomoke, Potomac, and Elizabeth.



R Shiny APP (under development) can provide location-specific results of the WQS attainment



Question:

How can we access these results?

Answer:

- An interactive R Shiny App is under development to make these results available as maps, time series plots, tables, and text summaries.
- These can be generated based on user selections of inputs.

WQS Attainment Indicator or Deficit
different assessment periods
different designated uses
Different tidal segments
different WQS criterion
different tidal systems
different states
long-term and short-term trends

We are looking for your feedback.

1. What are some of the technical issues you'd like us to work with you on between now and 2025?
   - A. Categorize patterns and trends of attainment for locations of interests to me
   - B. Explore drivers of attainment for locations of interests to me
   - C. Investigate whether nutrient reductions have led to improvement in attainment at different locations
   - D. Investigate the impacts of climate changes on the pace and direction of attainment
   - E. Other – provide text input
2. What are the ways you want us to work with you and communicate this information?
   - A. Develop fact sheets / technical reports to summarize the results and findings already available
   - B. Conduct webinars to disseminate the results and findings already available
   - C. Establish small group meetings to delve into the results and findings already available
   - D. Try out the R Shiny APP and provide feedback to us to modify/enhance its capabilities
   - E. Provide feedback to influence future research and analysis directions
   - F. Suggest other venues that you see important for collaboration and information exchange – please list with a text box
   - G. Other – provide text input
3. Longer term, what issues do you see after 2025 that you'll need help with?
   - A. Sustain the existing monitoring and analysis and expand monitoring and analysis with new technology and algorithms (e.g., satellite imagery, vertical monitoring of DO, salinity, and temperature, 4-D interpolator)
   - B. More complete accounting for the WQS criteria
   - C. Further explain the attainment patterns and trends
   - D. Other - provide text input

Appendix

The pace of progress

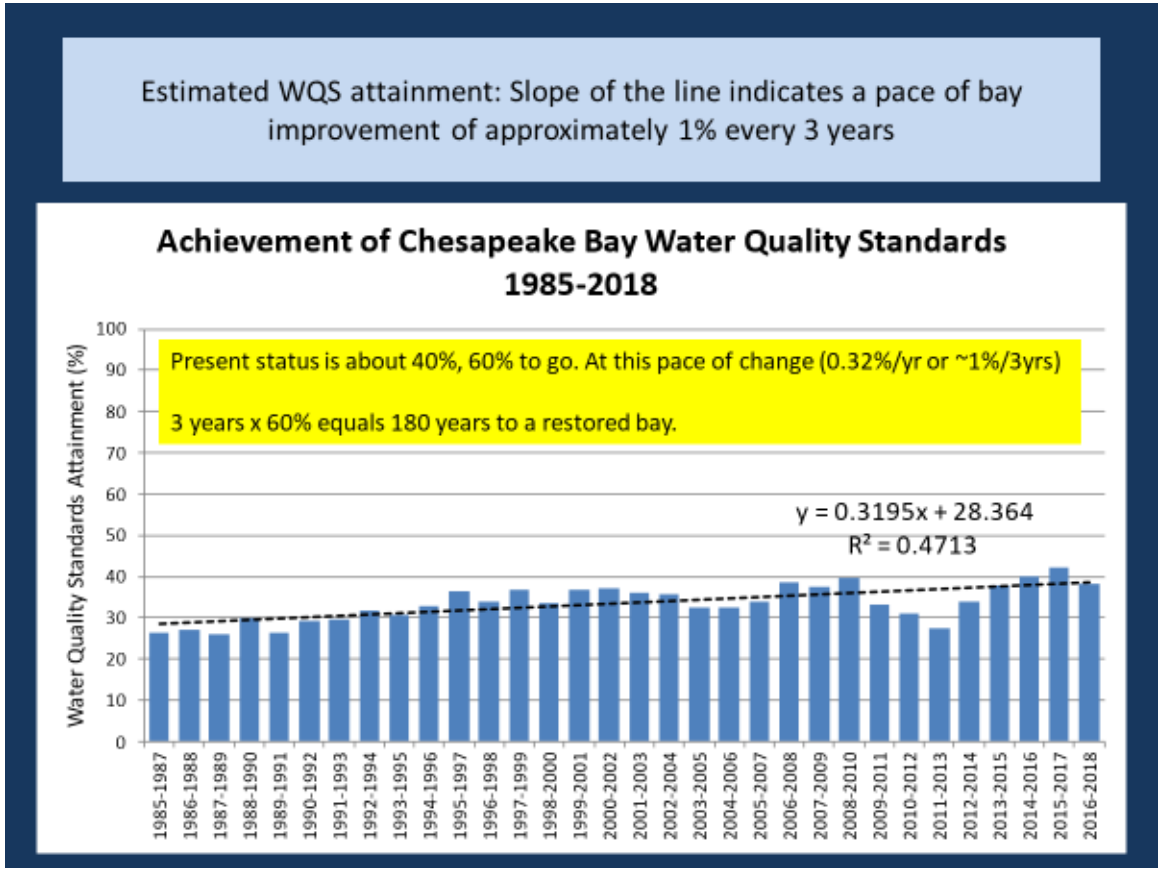
1980s: mid-20s% estimated WQS attainment.

2018: about 40% estimated WQS attainment

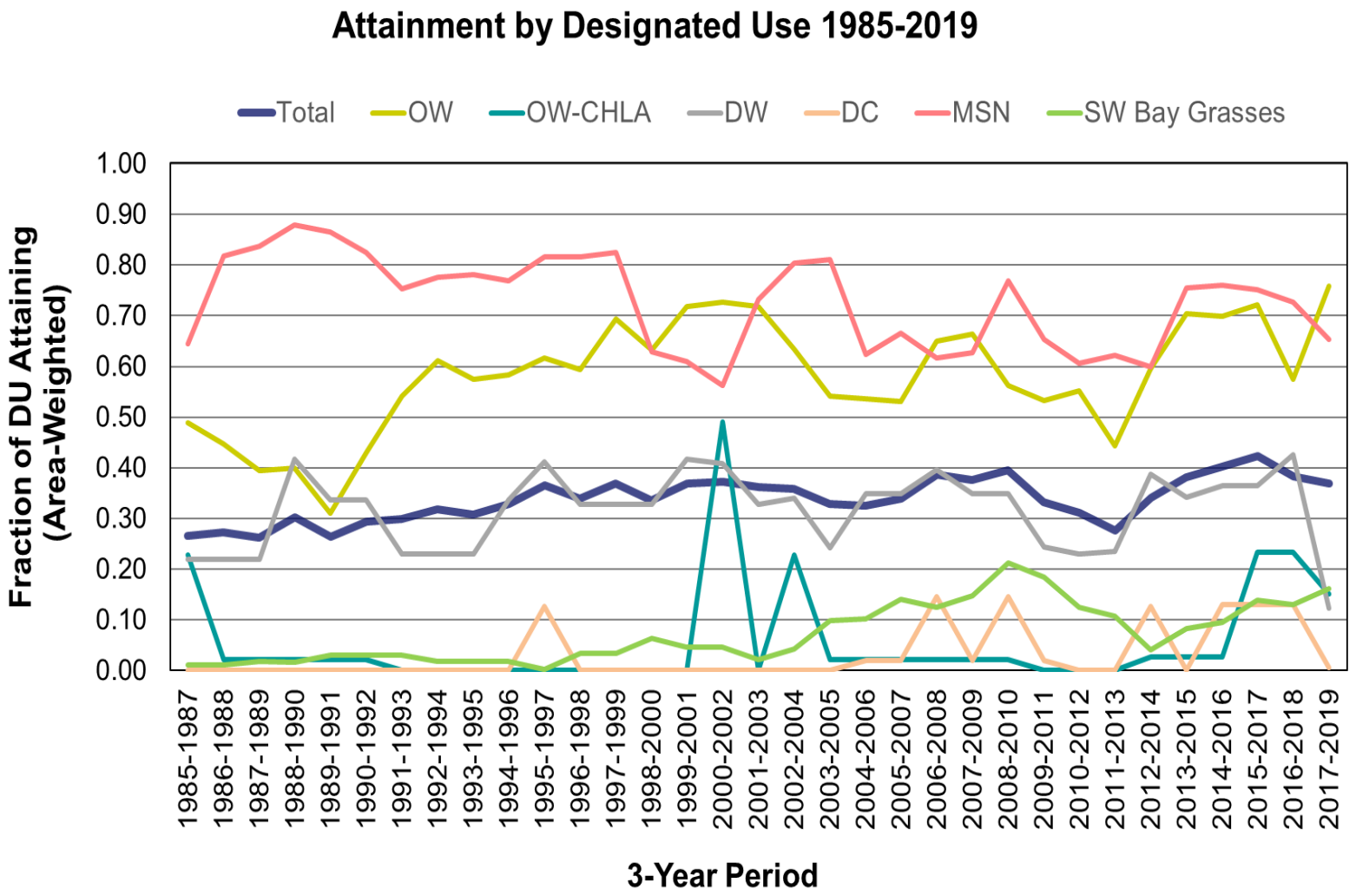
Progress: About 1% improvement every 3 years

Time to goal: Estimated 180 years

Opportunity: Management and policy decisions to change the pace of progress are in your hands



Attainment by Designated Use (DU)

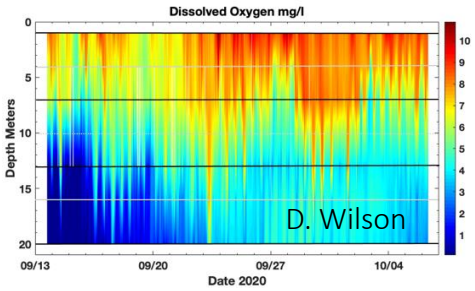


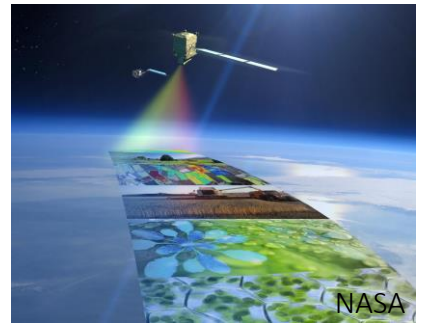
- Declines in DO (mainly DC and DW) and chlorophyll *a* impacted the attainment results between 2016-2018 and 2017-2019, potentially reflecting short-term fluctuations in weather and associated river inputs.

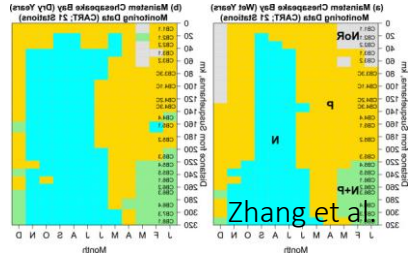
- OW DO has improved, achieving its best condition ever since monitoring began in 1985, which may be an indication of increasing resilience in the bay ecosystem over the long term.

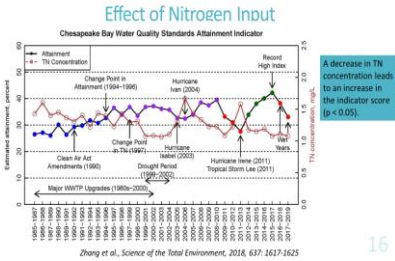
Targeted improvements in monitoring and analysis in the estuary: What's coming?

- Incorporation of Community-based (Citizen) Science data for the next WQS attainment assessment (2018-2020)
- Deployment of more continuous high-temporal frequency vertical monitoring of DO, Salinity, Temperature
- Satellite-based resource assessments (e.g., SAV)
- Funding proposal on nutrient limitation calibration/verification monitoring
- Analysis linking patterns in the water quality indicator with loads and other factors
- Development of new spatial interpolator (4D) to aid in the evaluation all Bay water quality criteria









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