

Short and long-term station-specific Secchi Depth trends

STAC Advancing Monitoring Approaches Workshop

April 22, 2022

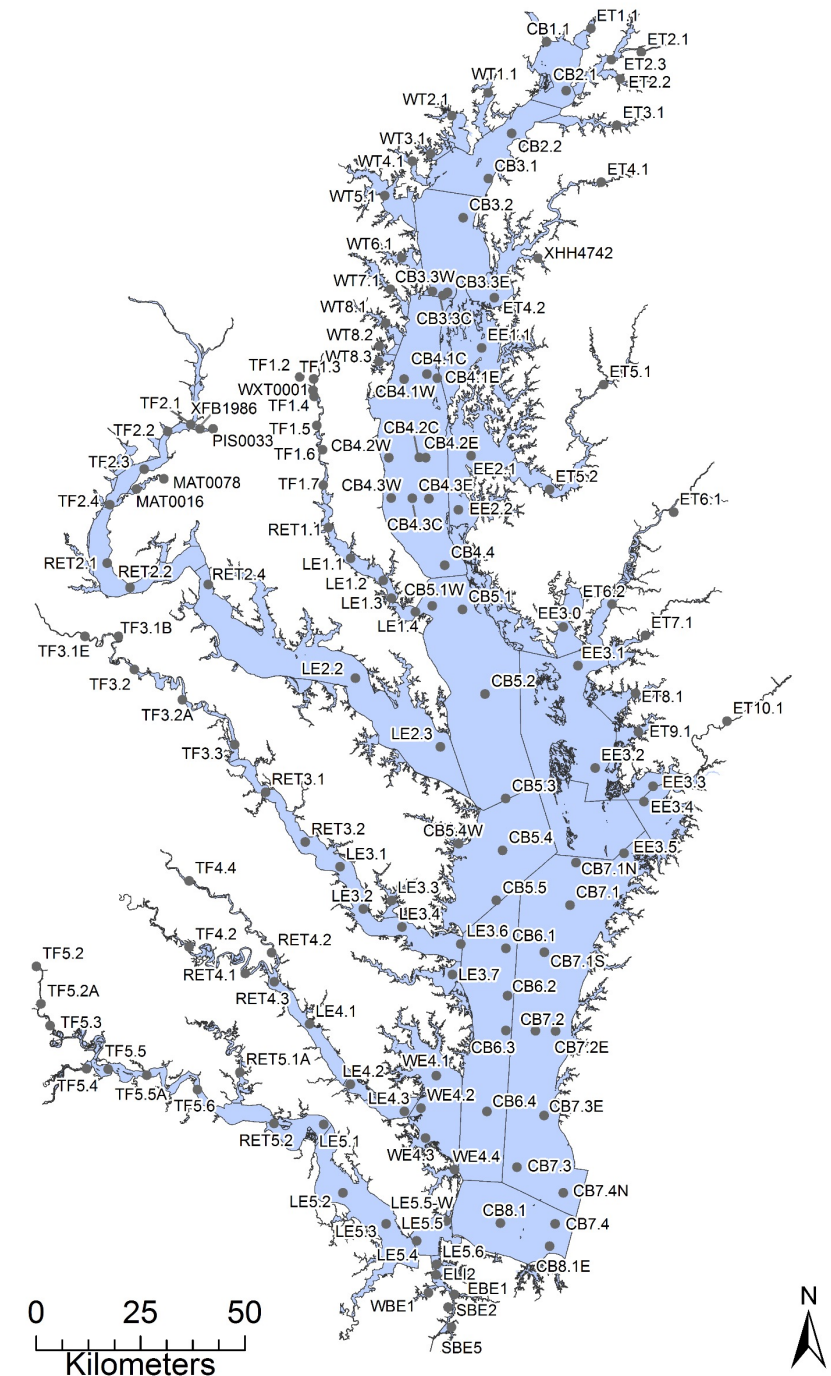
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UMCES at Chesapeake Bay Program

Results generated in collaboration with: Renee Karrh (MDDNR), Mike Lane (ODU), Cindy Johnson (VADEQ), Elgin Perry (consultant), Jon Harcum (Tetra Tech) and ITAT team

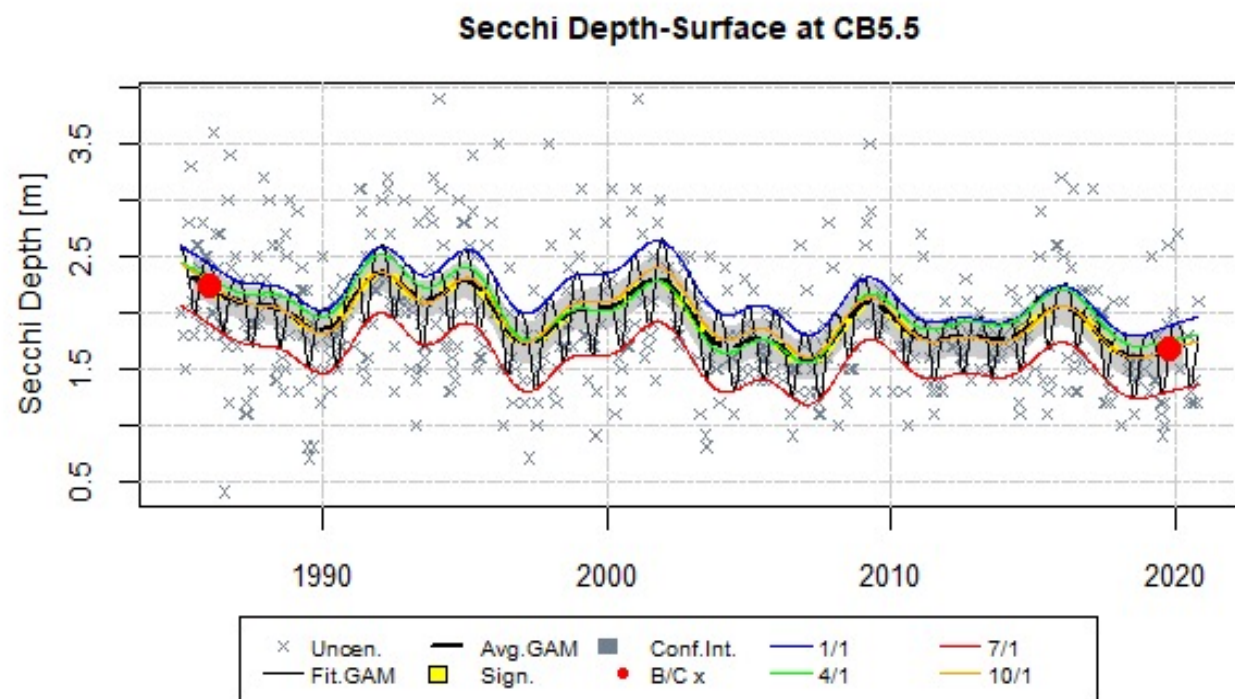
Annual Tidal Trend Analysis

- Focus on long-term fixed stations
 - 150+ stations (mostly mid-channel)
 - Data collection 1-2x/month since 1985
 - Multiple samples collected with depth: Surface & bottom + more depending on station & parameter
- Annual cycle in collaboration with MD, VA (and soon DC) analysts and ITAT team to analyze data and compute trends for:
 - Annual Secchi depth
 - Spring & summer, surface & bottom: Chlorophyll a
 - Annual surface & bottom TN, TP, DIN, PO4, TSS, water temp, salinity
 - Summer surface & bottom DO



Annual Observed Secchi Depth

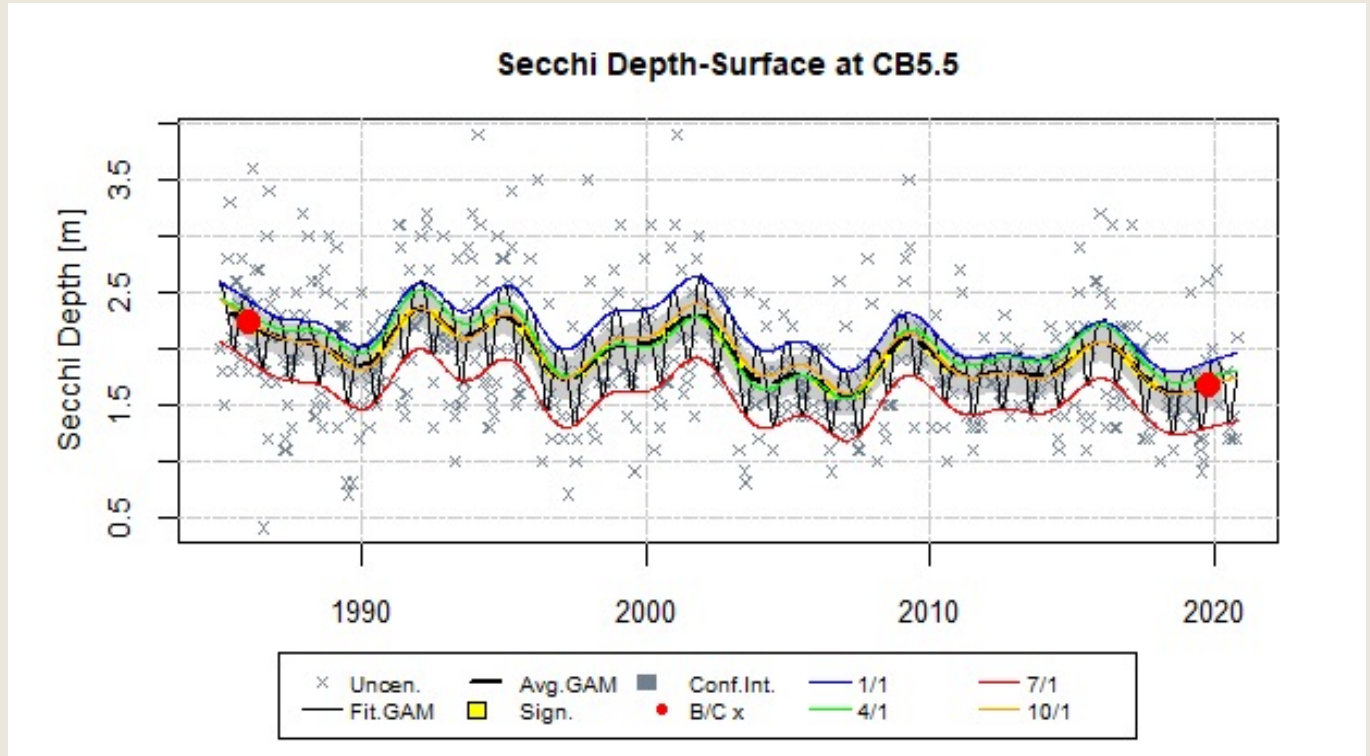
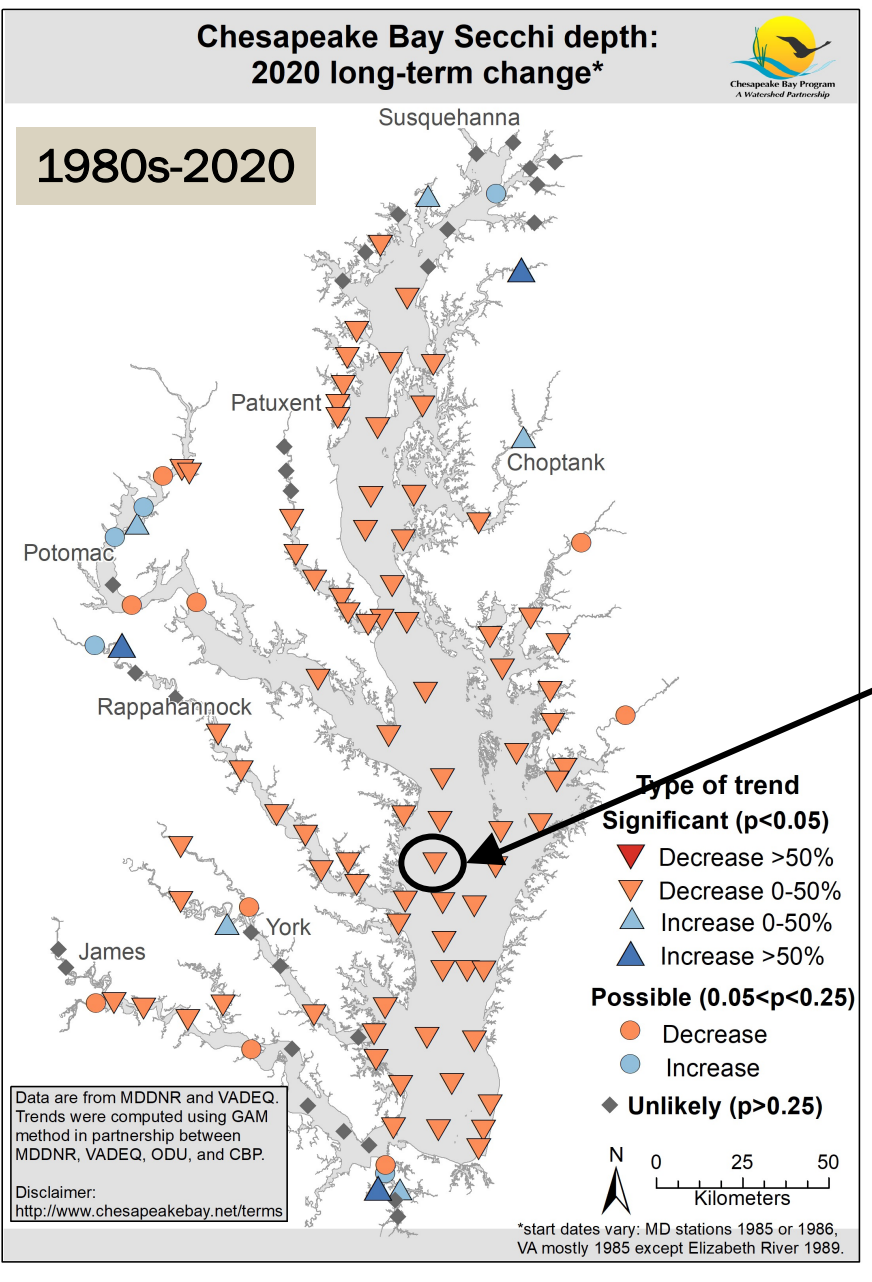
- Statistical Generalized Additive Model (GAM) fit to all Secchi measurements at each station
 - *Captures non-linear patterns in the data*
 - *Can be used with data that is not spaced regularly*
 - *Generates observed and flow-adjusted patterns over time*
- Results extracted from the full models to summarize change across different times



Murphy et al. 2019. Environ. Modelling Software 118: 1-13.

<https://doi.org/10.1016/j.envsoft.2019.03.027>

Annual Observed Secchi Depth

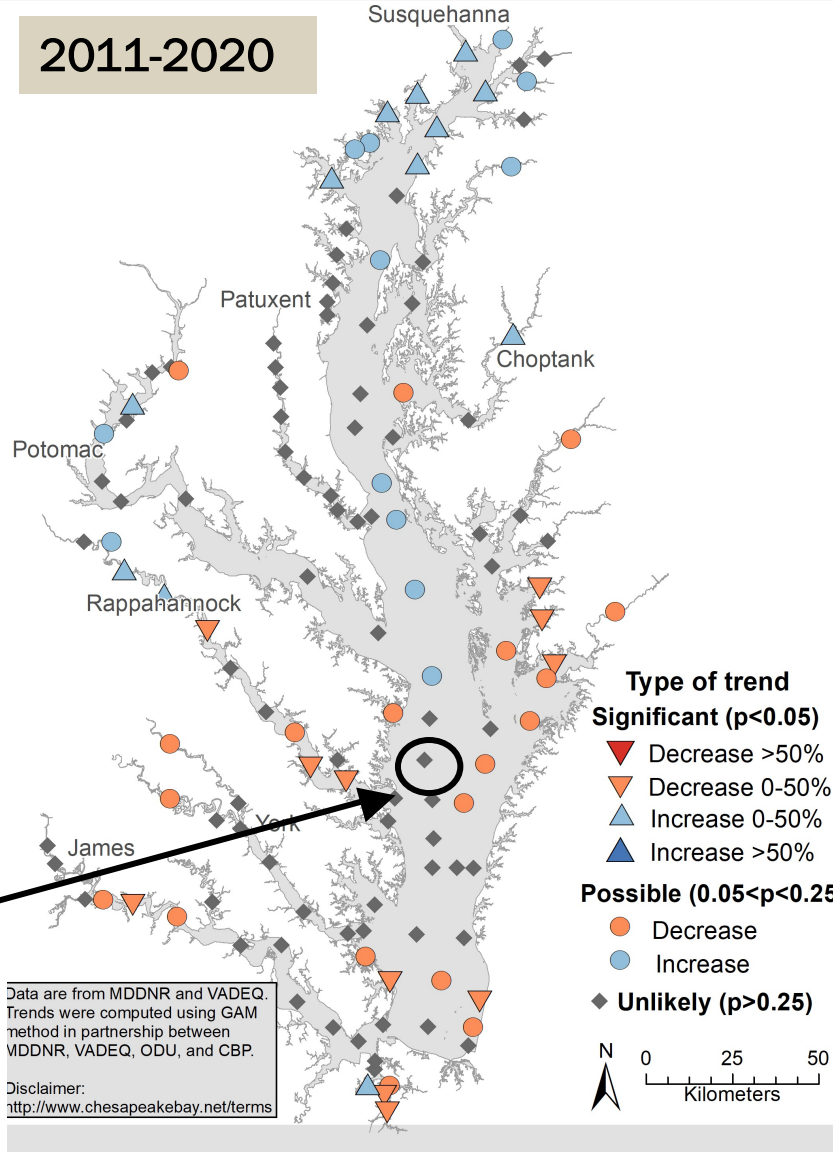


Annual Observed Secchi Depth

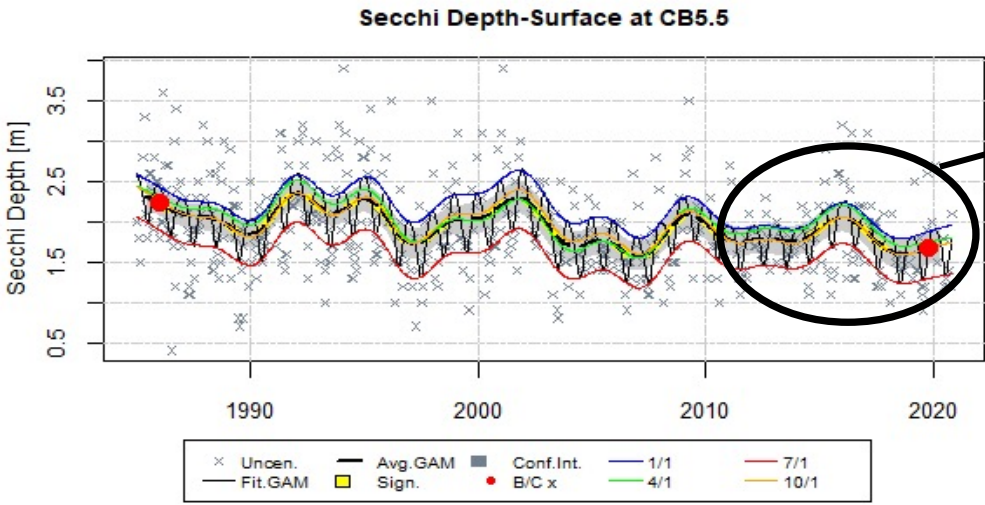


Chesapeake Bay Secchi depth: 2011-2020 change

2011-2020



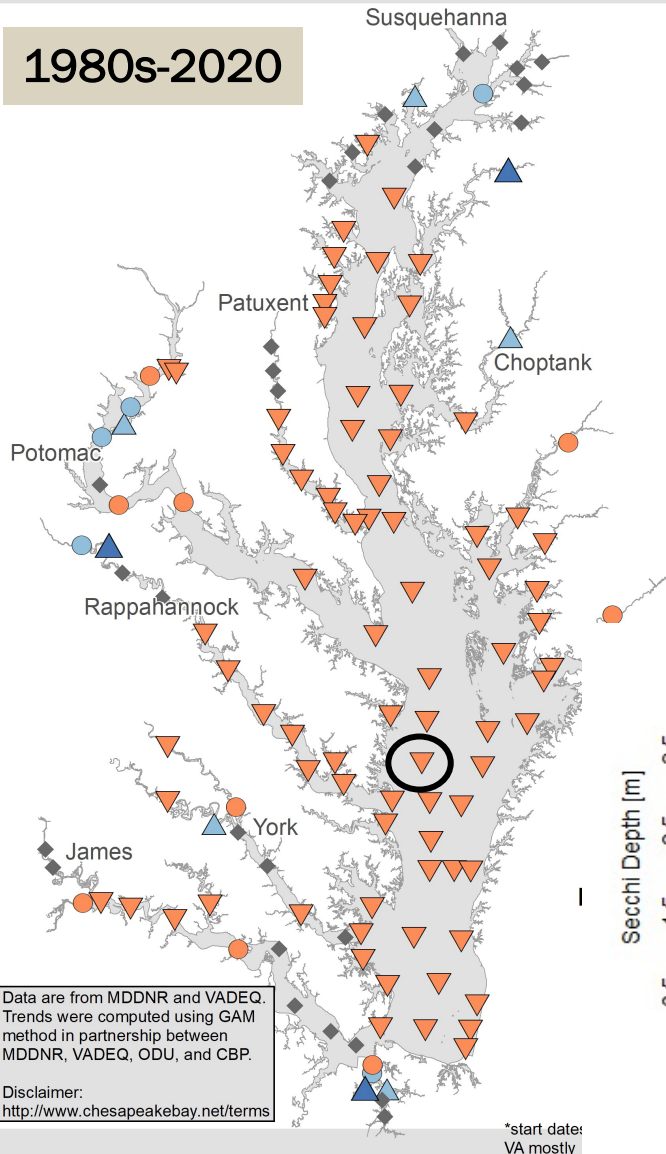
Patterns vary, but this example shows a long-term degradation, and short-term plateau



Chesapeake Bay Secchi depth: 2020 long-term change*



1980s-2020



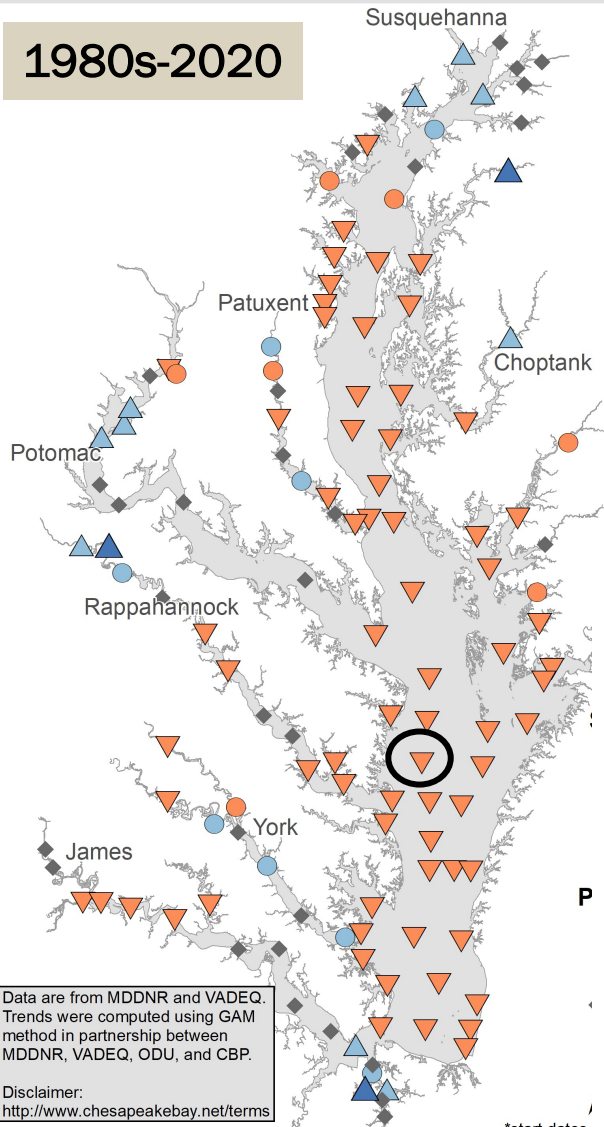
*start date: VA mostly

Annual Flow-adjusted Secchi Depth

Chesapeake Bay Secchi depth: 2020 long-term flow-adjusted change*

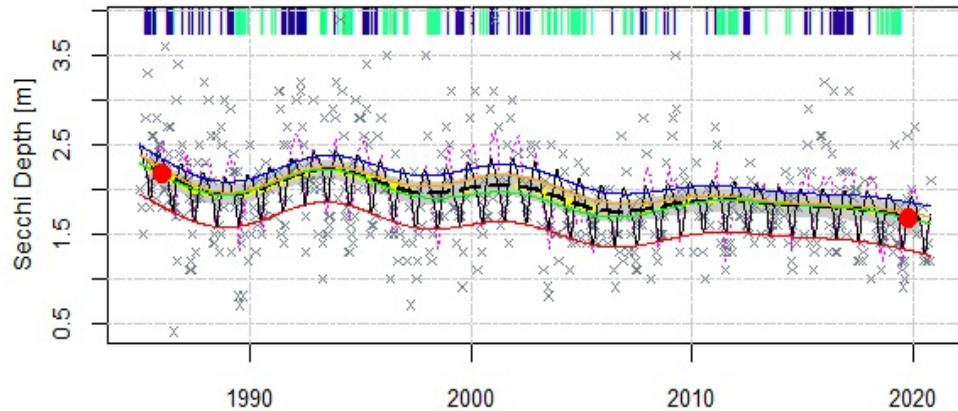


1980s-2020



- Flow-adjusted show results “if flow had been average”
- Not too much difference from observed for secchi (this year at least)

Secchi Depth-Surface at CB5.5

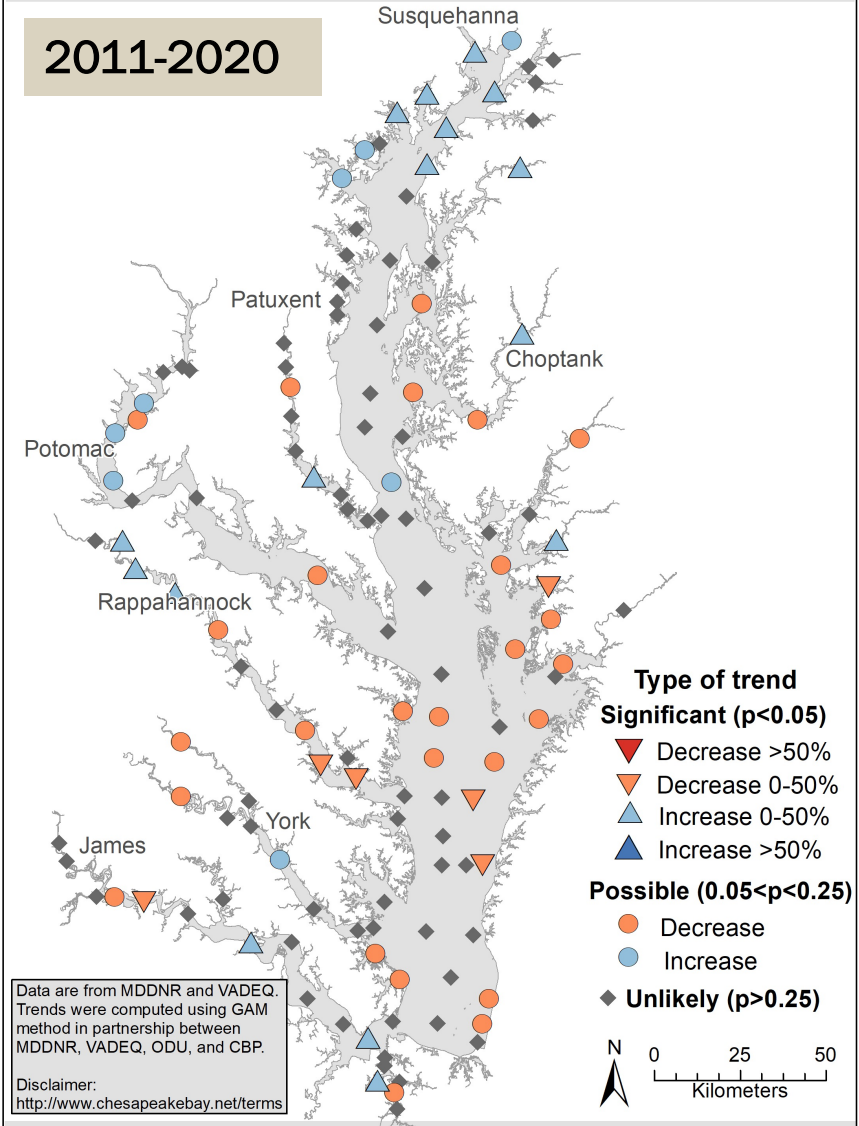


*start dates
VA mostly 1985 except Elizabeth River 1989.

Chesapeake Bay Secchi depth: 2011-2020 flow-adjusted change

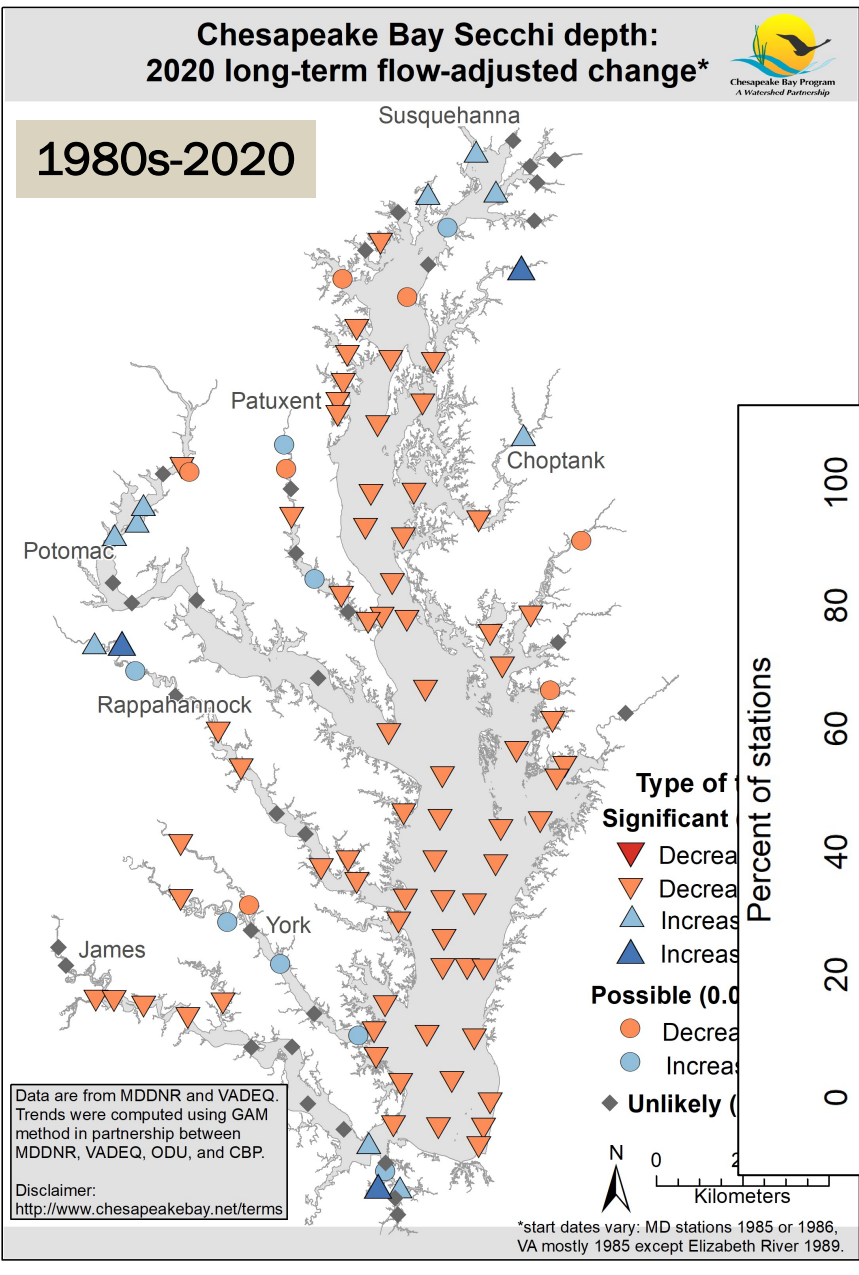


2011-2020

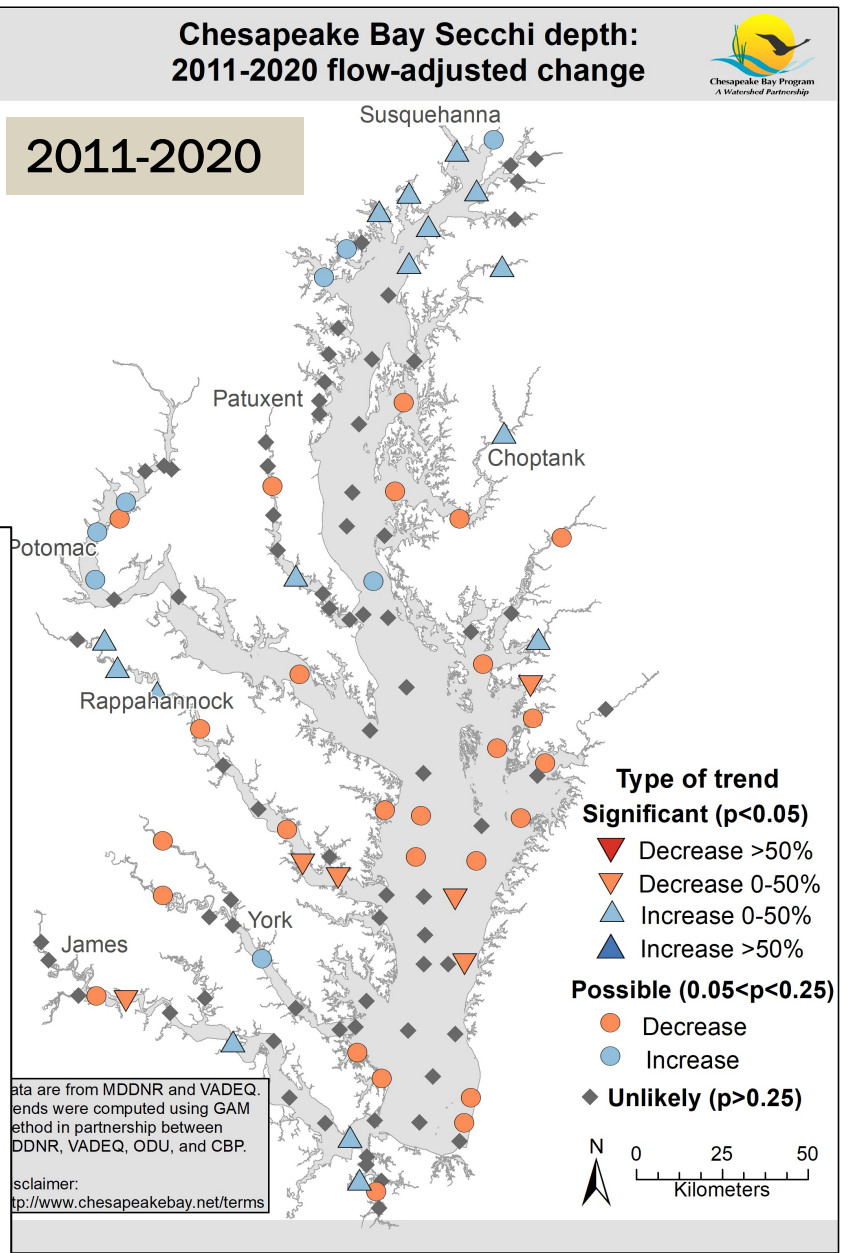
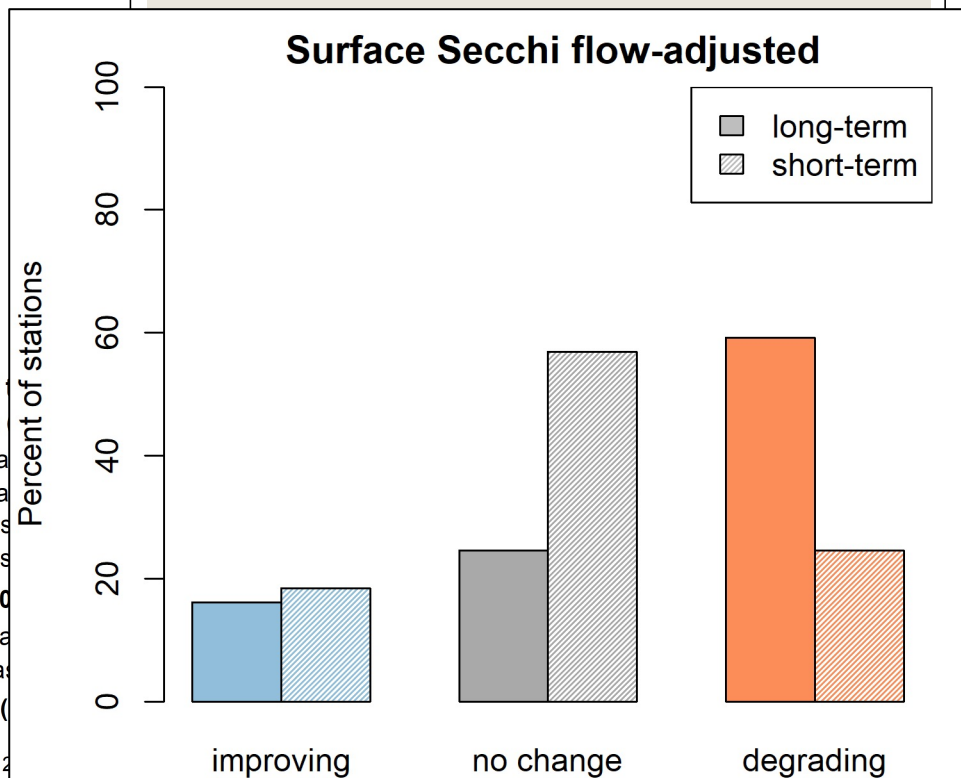


Data are from MDDNR and VADEQ.
Trends were computed using GAM
method in partnership between
MDDNR, VADEQ, ODU, and CBP.
Disclaimer:
<http://www.chesapeakebay.net/terms>

Annual Flow-adjusted Secchi Depth

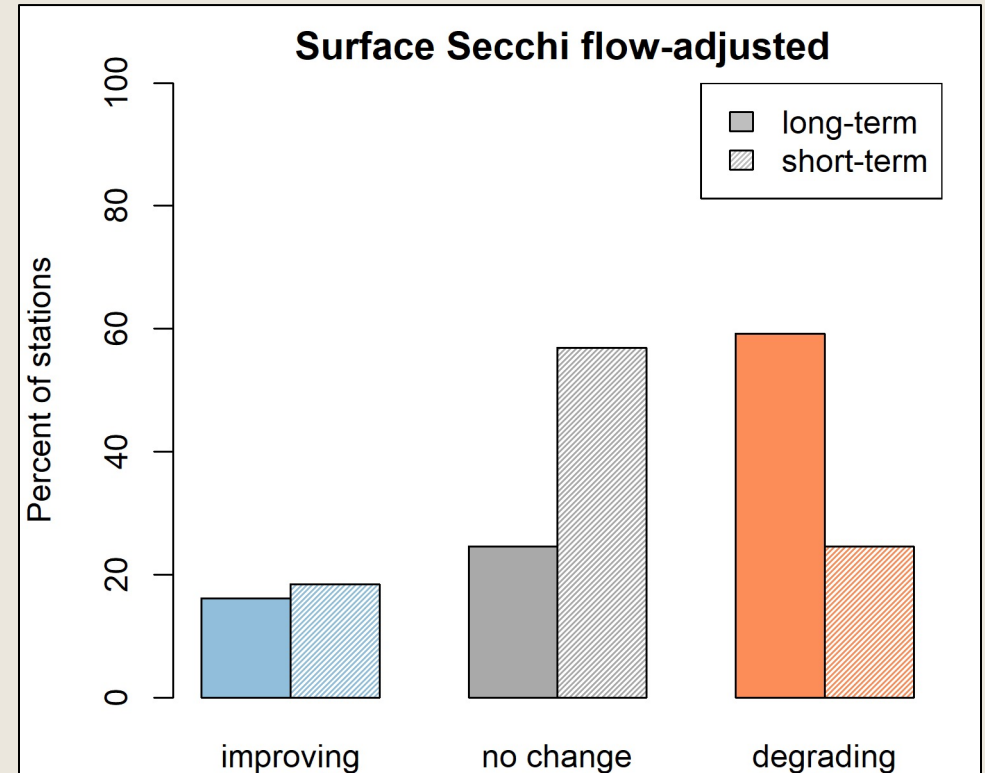


- We also aggregate all stations into a bar graph



Summary: 2020 Secchi Depth Trends

- Annual maps summarize our very detailed GAM analysis of the monitoring data to give bay-wide picture
- We also found these bar graphs help with a big-picture summary as well
 - e.g., can see how the majority of the stations have long-term degrading Secchi, but over the short-term, that swapped to be mostly “no change” for the majority of the stations

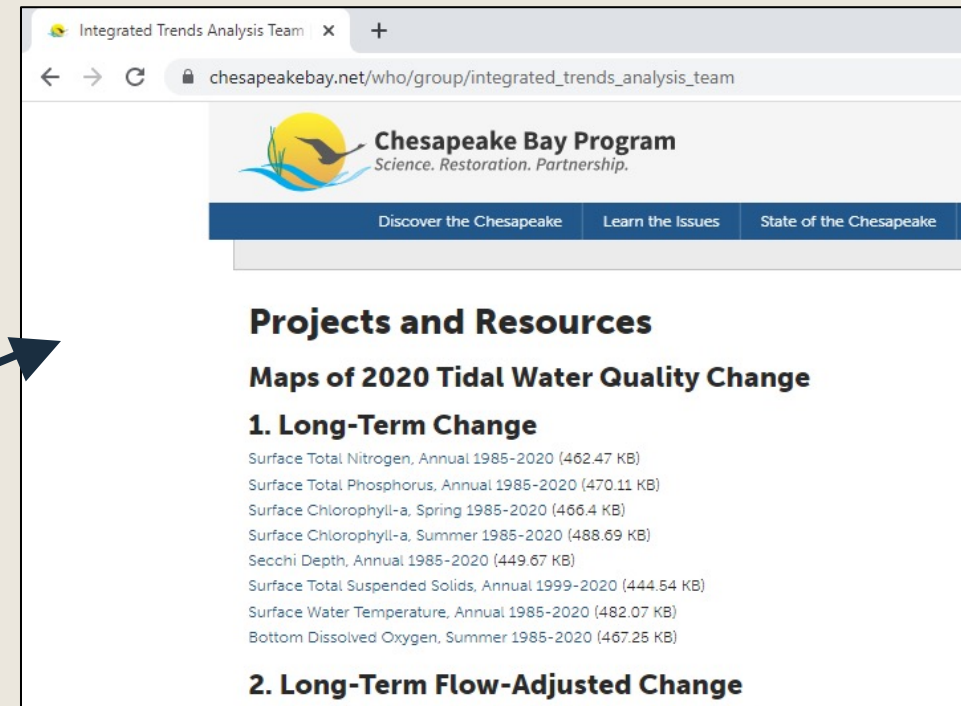


Accessing Tidal Trends

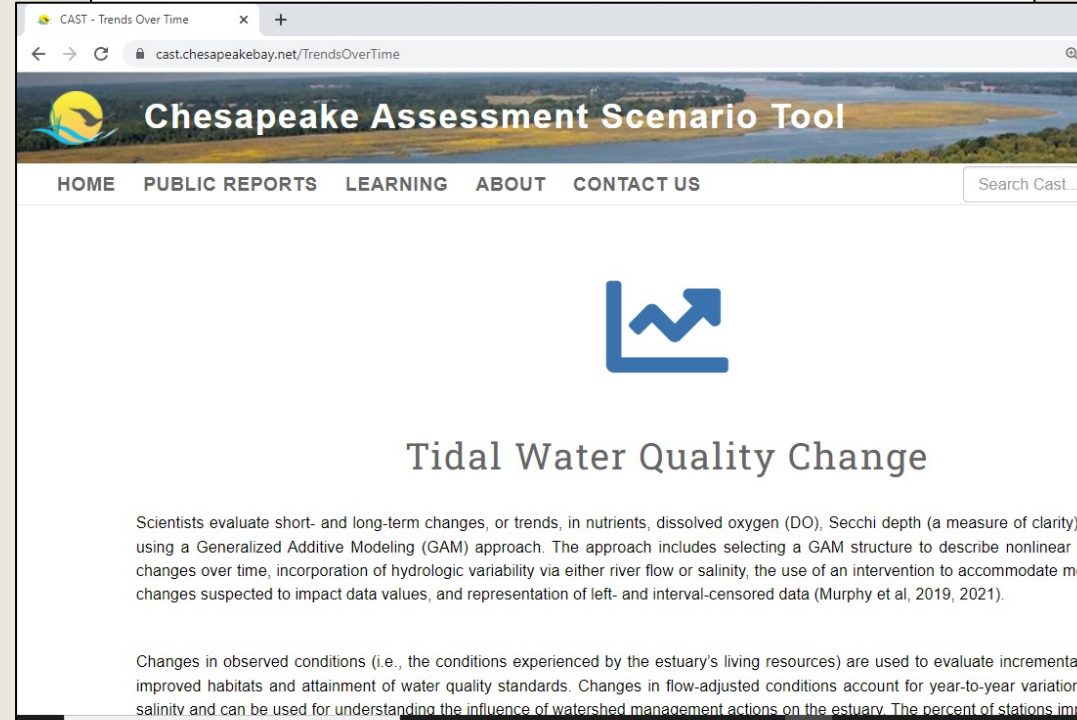
- ITAT webpage
 - 2020 maps are available for all parameters.
 - https://www.chesapeakebay.net/who/group/integrated_trends_analysis_team
- Baytrendsmap via CAST
 - Summary file, table, and interactive website to explore the trends.
 - <https://cast.chesapeakebay.net/TrendsOverTime>

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The screenshot shows a web browser window with the URL [chesapeakebay.net/who/group/integrated_trends_analysis_team](https://www.chesapeakebay.net/who/group/integrated_trends_analysis_team). The page features the Chesapeake Bay Program logo and navigation links: "Discover the Chesapeake", "Learn the Issues", and "State of the Chesapeake". The main content area is titled "Projects and Resources" and includes a section for "Maps of 2020 Tidal Water Quality Change". Under this section, there are two sub-sections: "1. Long-Term Change" and "2. Long-Term Flow-Adjusted Change". The "1. Long-Term Change" section lists several parameters with their respective data ranges and file sizes: Surface Total Nitrogen, Annual 1985-2020 (462.47 KB); Surface Total Phosphorus, Annual 1985-2020 (470.11 KB); Surface Chlorophyll-a, Spring 1985-2020 (466.4 KB); Surface Chlorophyll-a, Summer 1985-2020 (488.69 KB); Secchi Depth, Annual 1985-2020 (449.67 KB); Surface Total Suspended Solids, Annual 1999-2020 (444.54 KB); Surface Water Temperature, Annual 1985-2020 (482.07 KB); and Bottom Dissolved Oxygen, Summer 1985-2020 (467.25 KB).



The screenshot shows a web browser window with the URL cast.chesapeakebay.net/TrendsOverTime. The page features the Chesapeake Assessment Scenario Tool logo and navigation links: "HOME", "PUBLIC REPORTS", "LEARNING", "ABOUT", and "CONTACT US". The main content area is titled "Tidal Water Quality Change" and includes a blue line graph icon. Below the icon, there is a section titled "Tidal Water Quality Change" with a paragraph of text: "Scientists evaluate short- and long-term changes, or trends, in nutrients, dissolved oxygen (DO), Secchi depth (a measure of clarity) using a Generalized Additive Modeling (GAM) approach. The approach includes selecting a GAM structure to describe nonlinear changes over time, incorporation of hydrologic variability via either river flow or salinity, the use of an intervention to accommodate changes suspected to impact data values, and representation of left- and interval-censored data (Murphy et al, 2019, 2021)."