

Tidal Water Quality Trends

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Chesapeake Bay Program Office

*2020 trends run by **Renee Karrh** (MDDNR) and **Mike Lane** (ODU)
Coordinated through ITAT*

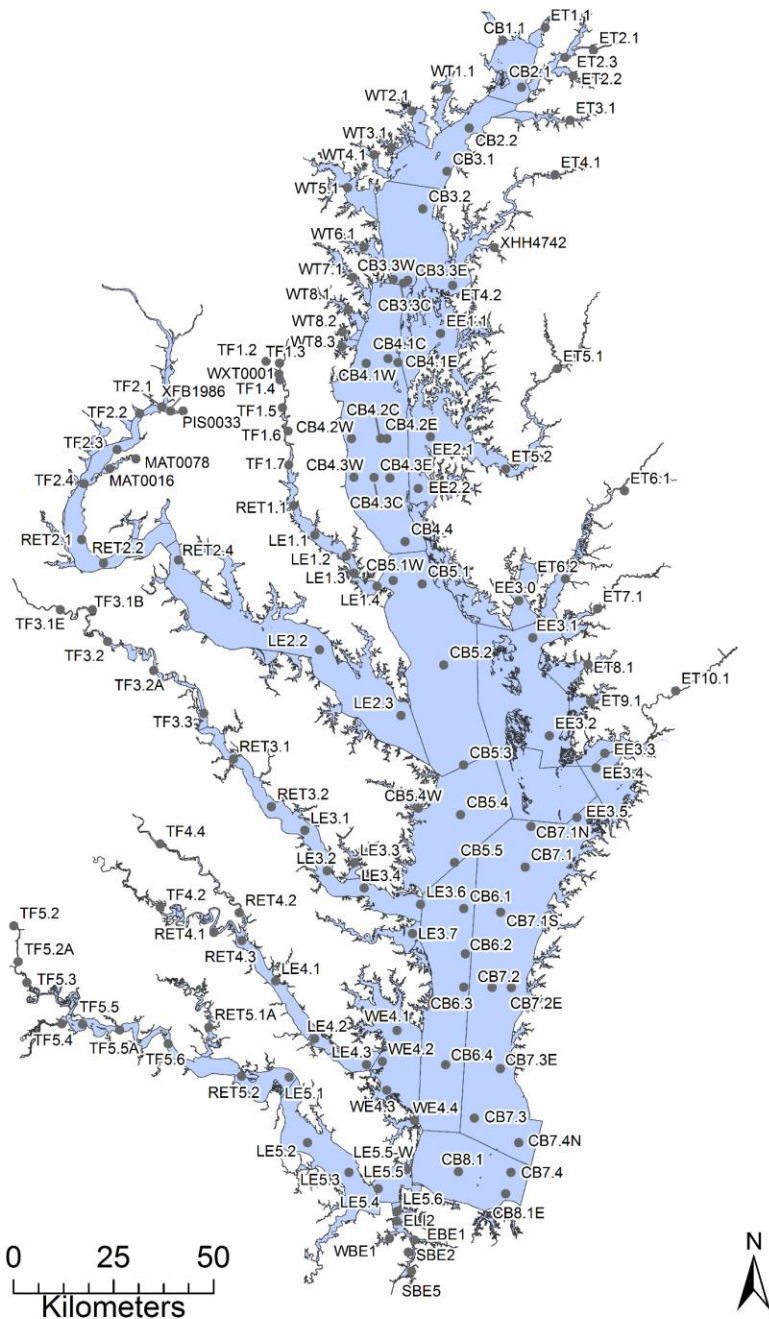
STAR meeting

Aug. 25, 2022



Extensive long-term coordinated tidal water quality monitoring

- MDDNR, VADEQ, DC and others have been sampling at 150+ stations since the 1980s 1-2 times/month
- Nutrients, chlorophyll-*a*, dissolved oxygen, Secchi depth, salinity, temperature, and others



Matt Rath/Chesapeake Bay Program

Annual tidal trend results

- Multiple parameters at every station:
 - Nutrients: Total Nitrogen, Dissolved Inorganic Nitrogen, Total Phosphorus, Orthophosphate
 - Secchi Depth, Chlorophyll-*a*, Dissolved Oxygen, Total Suspended Solids
 - Temperature, Salinity
- Capture the spatial and temporal dynamics:
 - Surface & bottom
 - True conditions & flow-adjusted
- Post-process analysis possible for time periods and seasons:
 - Long-term (ideally 1985-present)
 - Short-term (last 10 years)
 - Spring & summer chlorophyll-*a*, summer bottom DO

Annual tidal trend results

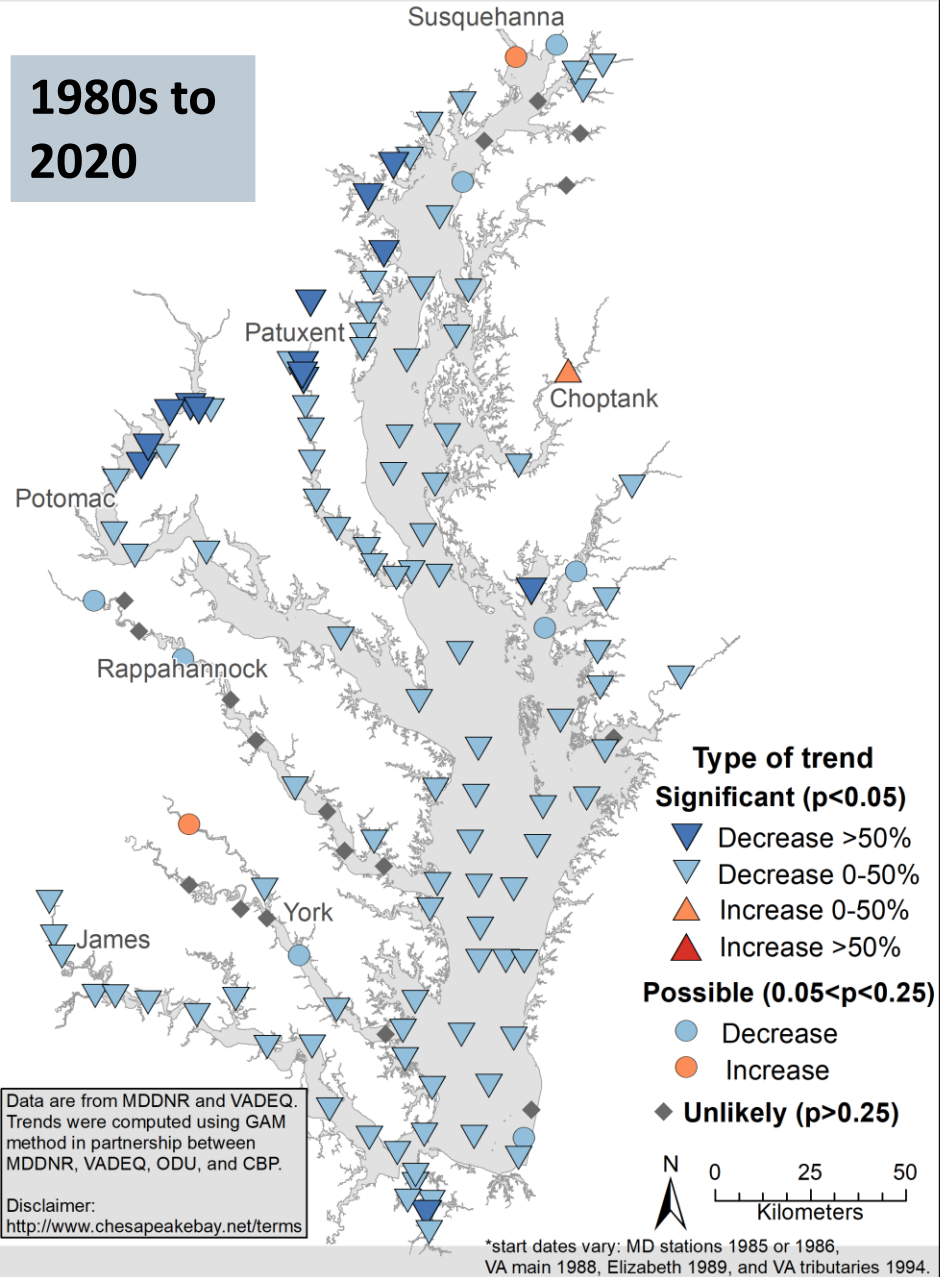
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TN

Chesapeake Bay Surface Total Nitrogen: 2020 long-term flow-adjusted change*



1980s to
2020

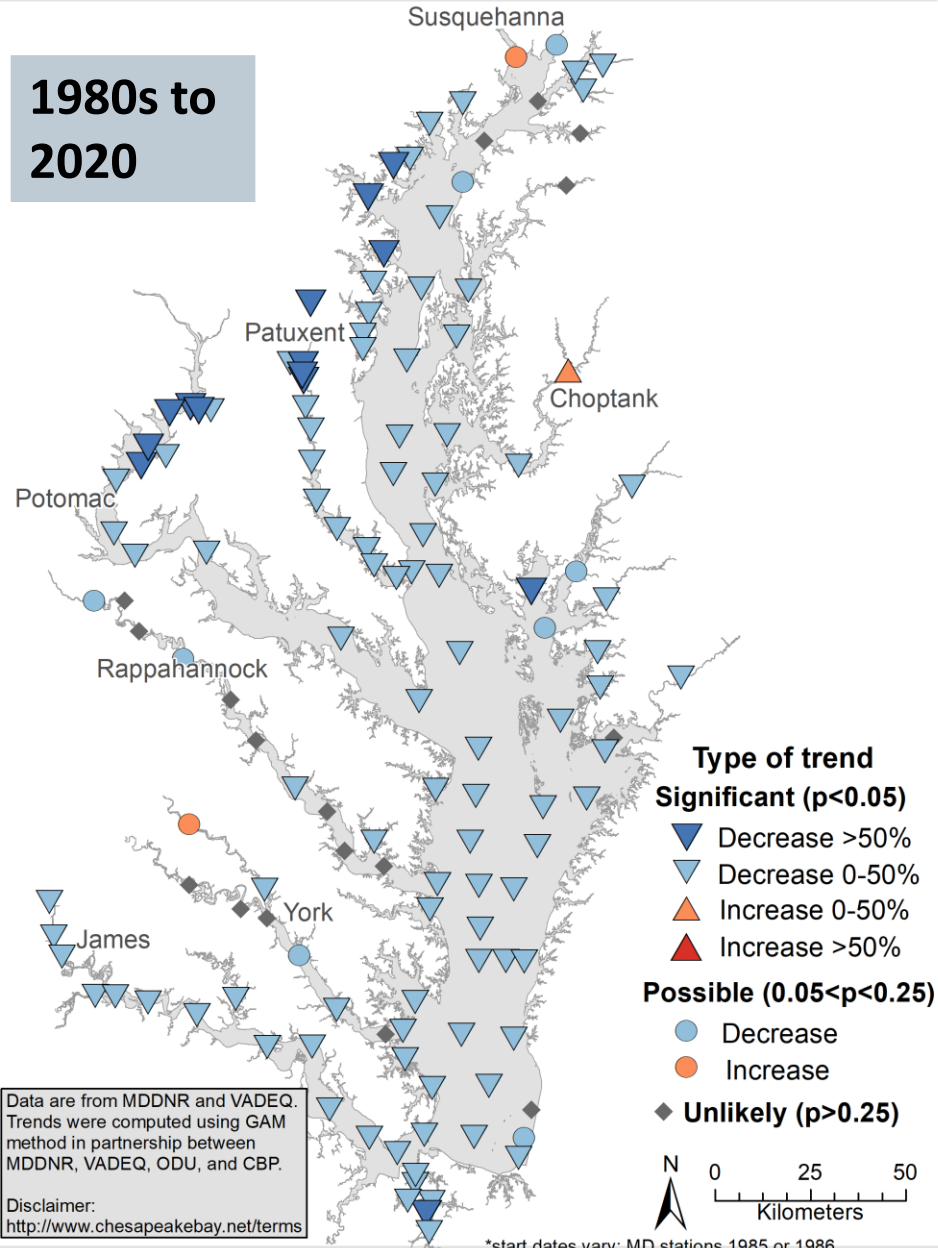


TN

Chesapeake Bay Surface Total Nitrogen: 2020 long-term flow-adjusted change*



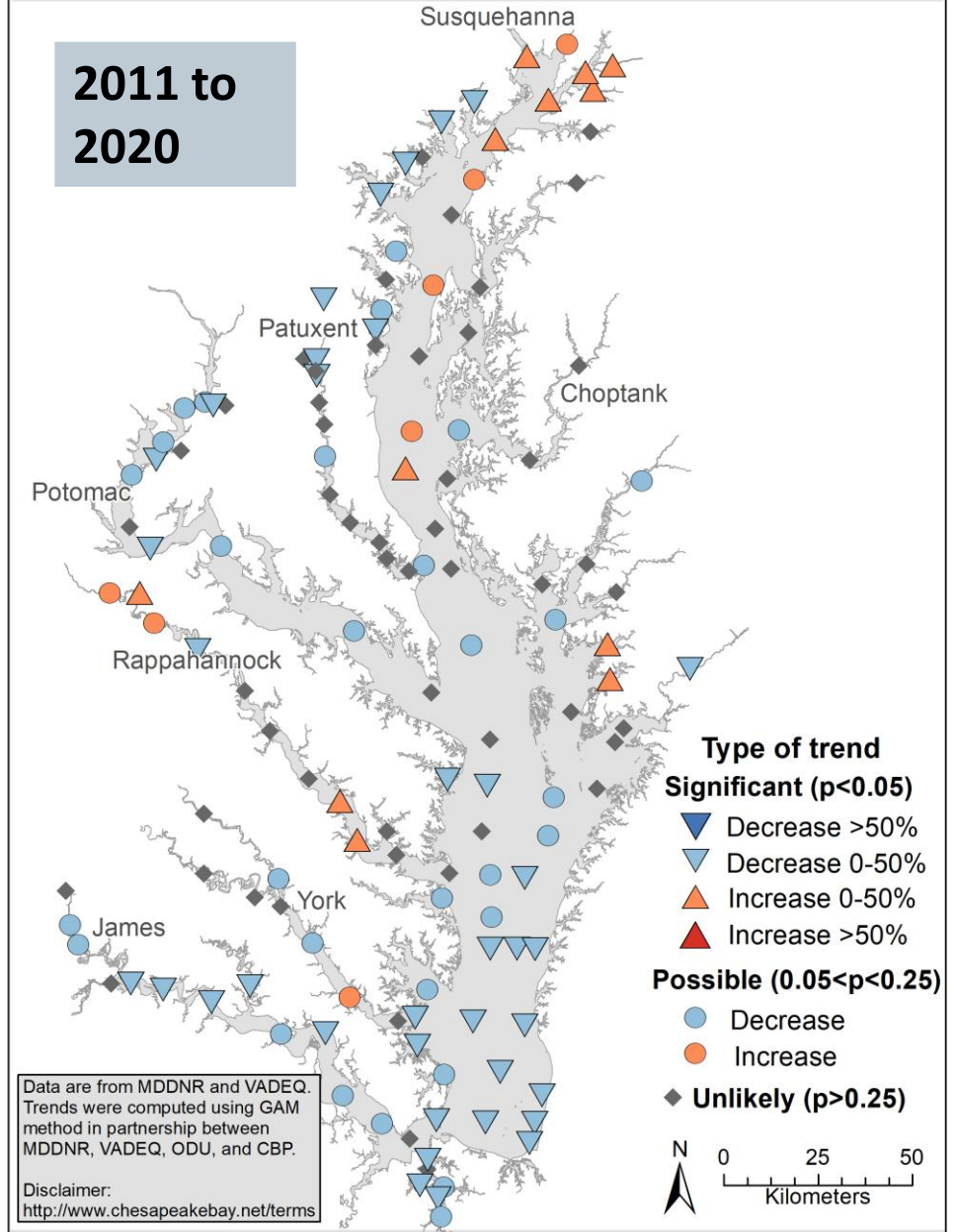
1980s to
2020



Chesapeake Bay Surface Total Nitrogen: 2011-2020 flow-adjusted change*



2011 to
2020

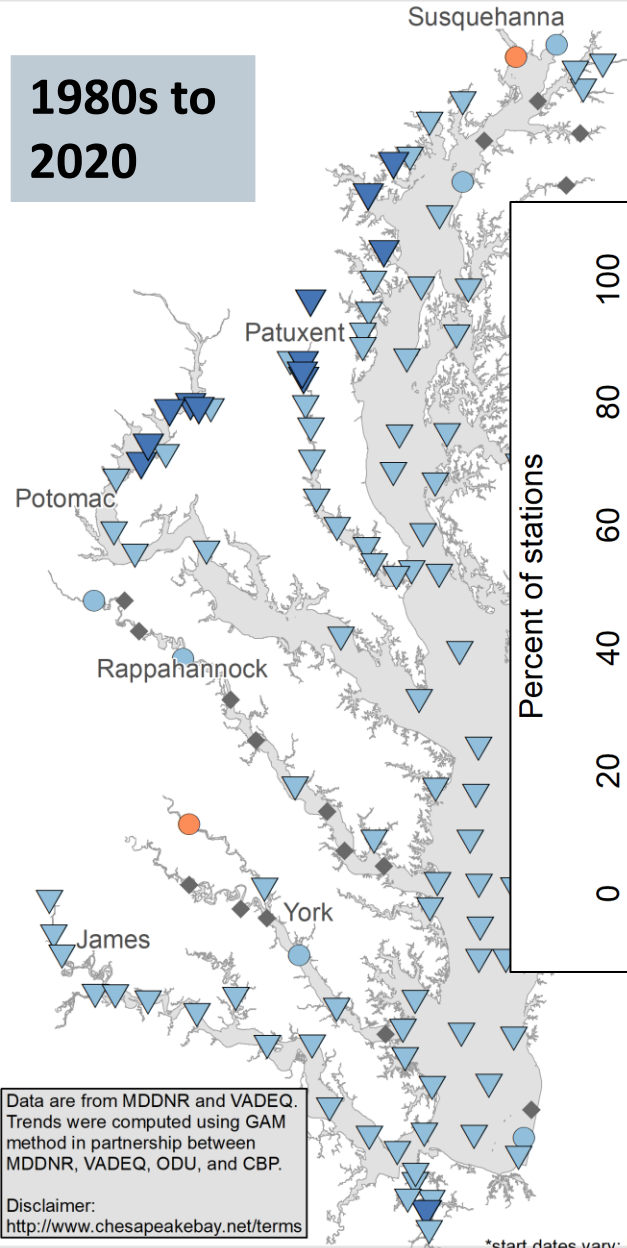


TN

Chesapeake Bay Surface Total Nitrogen: 2020 long-term flow-adjusted change*



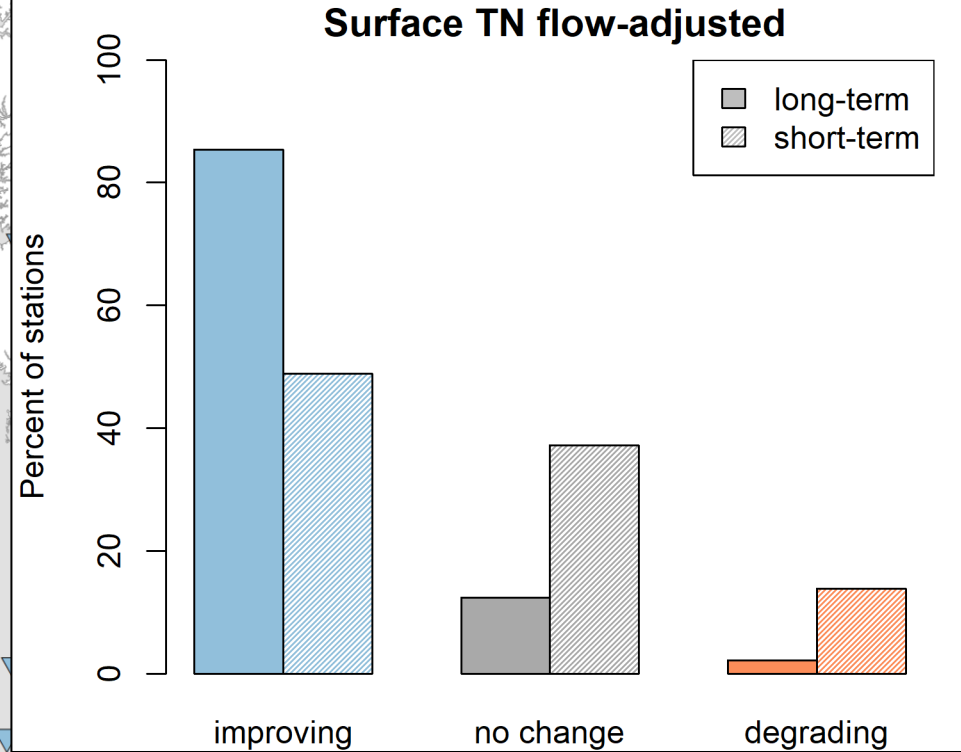
1980s to
2020



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>

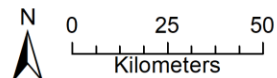
*start dates vary: MD stations 1985 or 1986, VA main 1988, Elizabeth 1989, and VA tributaries 1994.



Possible ($0.05 < p < 0.25$)

- Decrease
- Increase

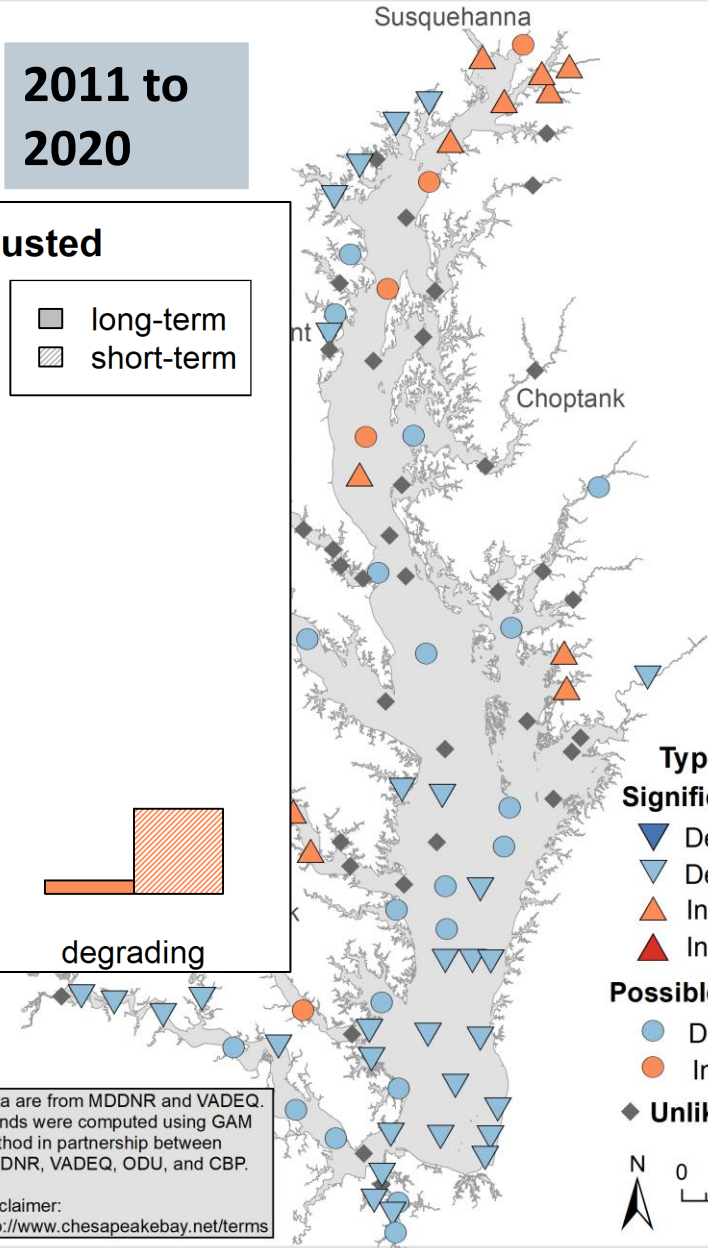
◆ Unlikely ($p > 0.25$)



Chesapeake Bay Surface Total Nitrogen: 2011-2020 flow-adjusted change*



2011 to
2020



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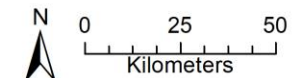
Type of trend
Significant ($p < 0.05$)

- ▼ Decrease >50%
- ▼ Decrease 0-50%
- ▲ Increase 0-50%
- ▲ Increase >50%

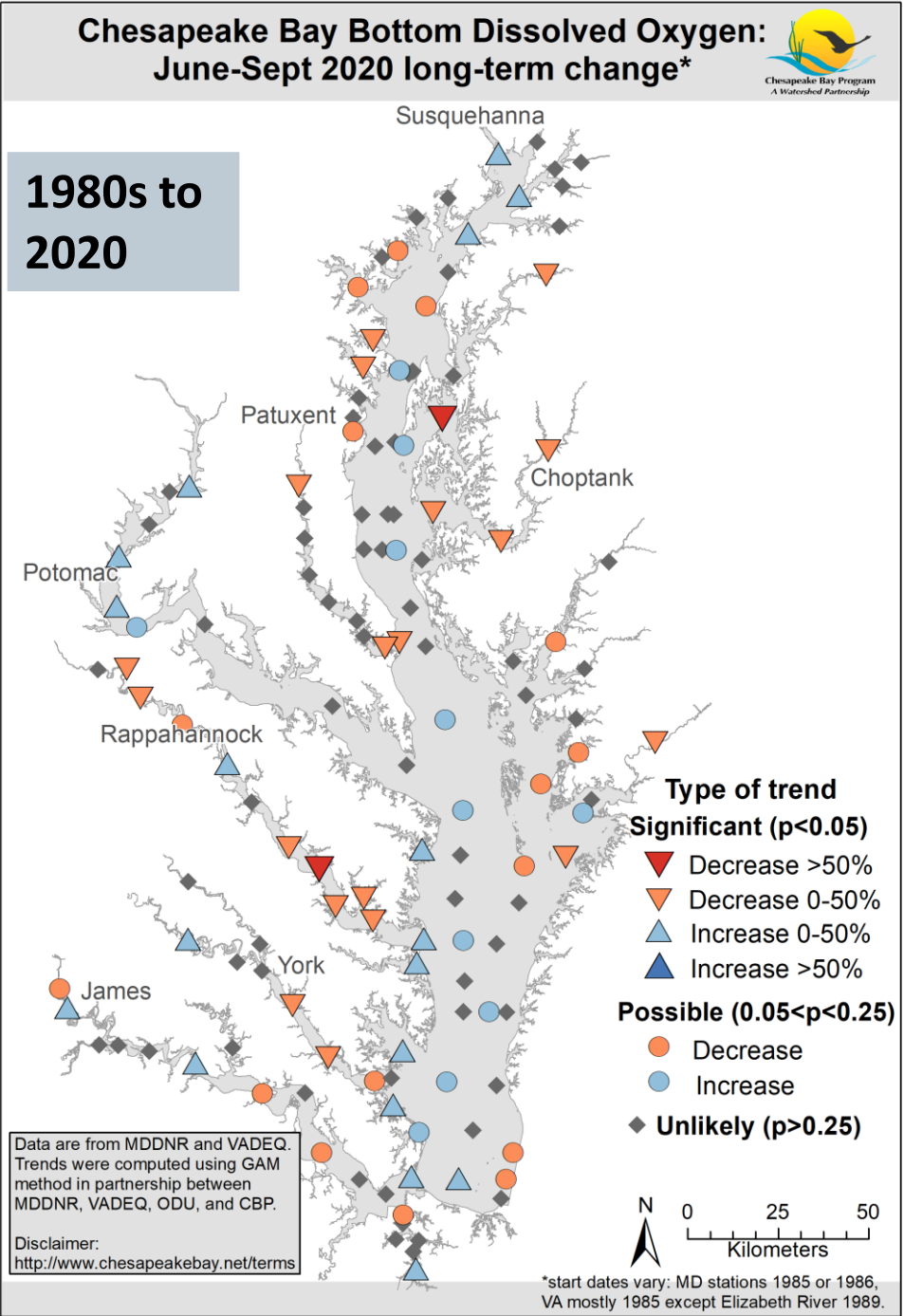
Possible ($0.05 < p < 0.25$)

- Decrease
- Increase

◆ Unlikely ($p > 0.25$)



DO

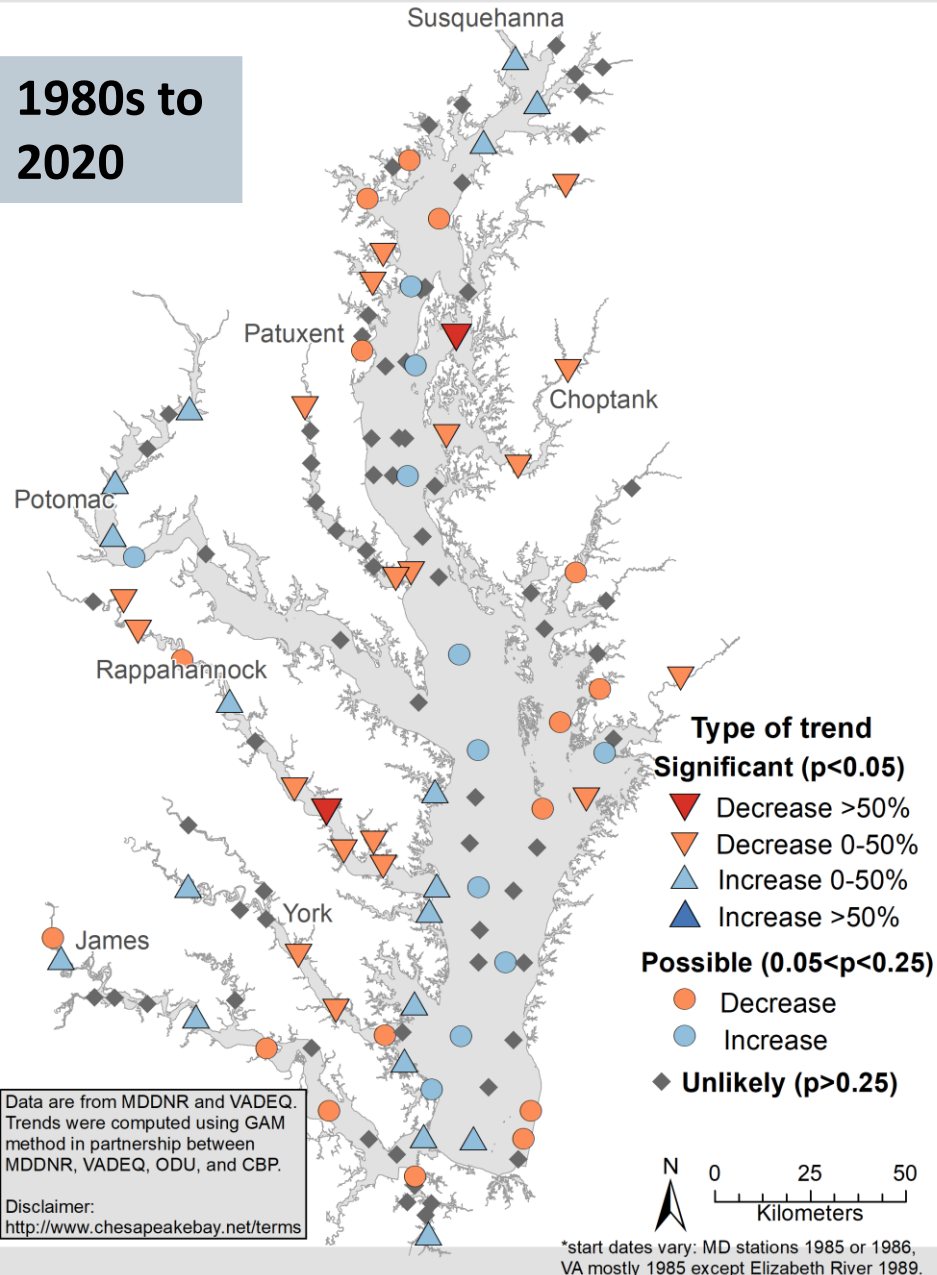


DO

Chesapeake Bay Bottom Dissolved Oxygen: June-Sept 2020 long-term change*



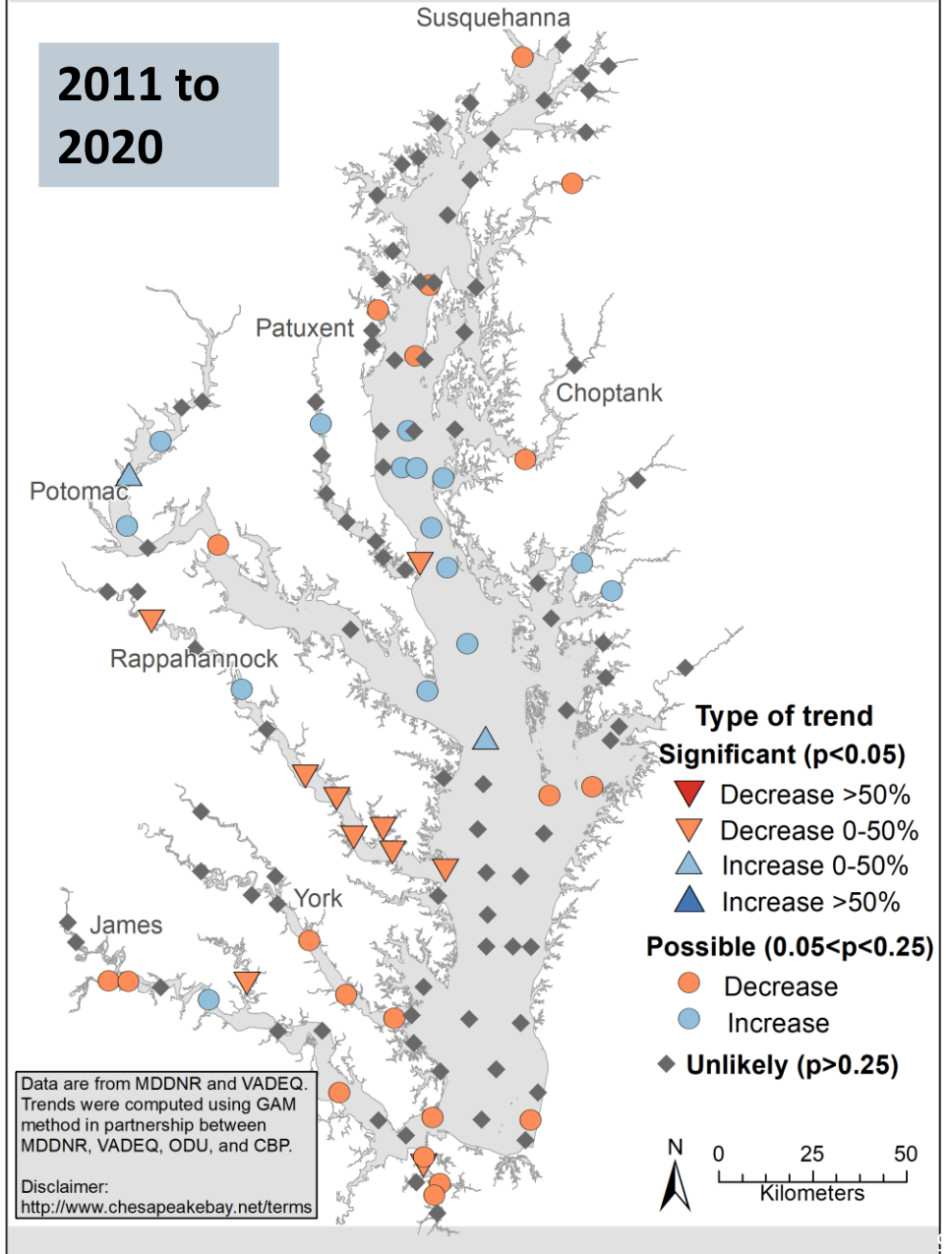
1980s to
2020



Chesapeake Bay Bottom Dissolved Oxygen: June-Sept 2011-2020 change



2011 to
2020

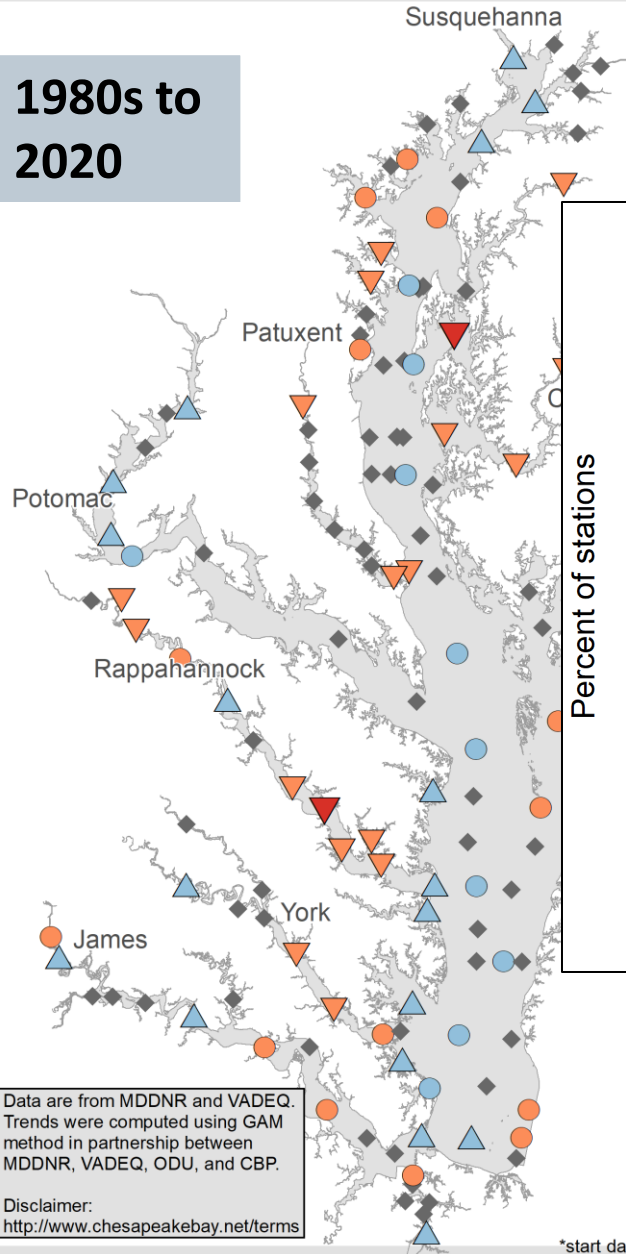


DO

Chesapeake Bay Bottom Dissolved Oxygen: June-Sept 2020 long-term change*



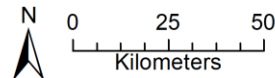
1980s to
2020



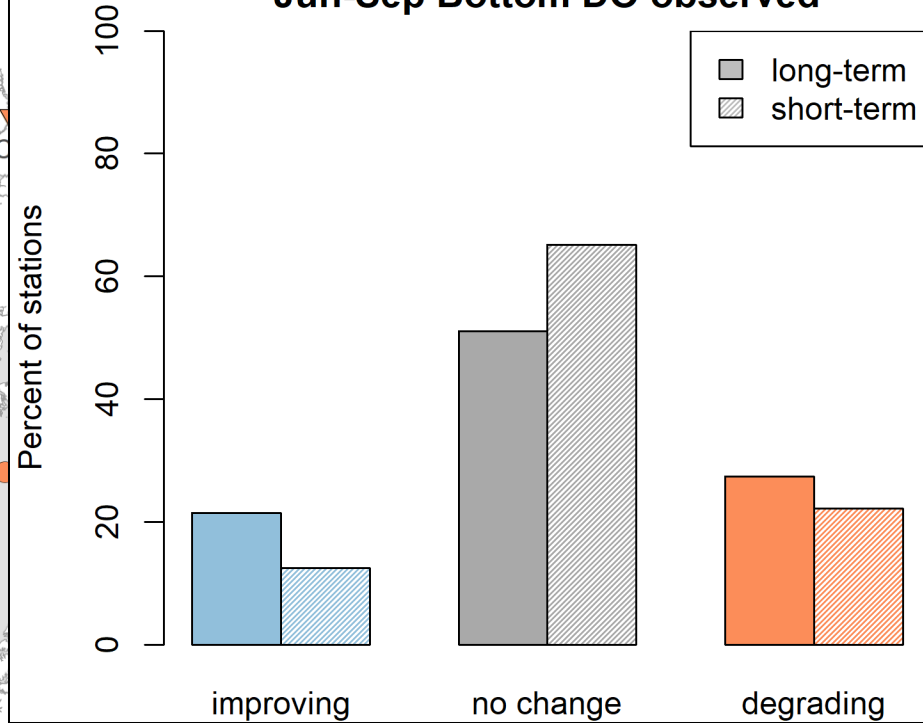
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*start dates vary: MD stations 1985 or 1986, VA mostly 1985 except Elizabeth River 1989.



Jun-Sep Bottom DO observed

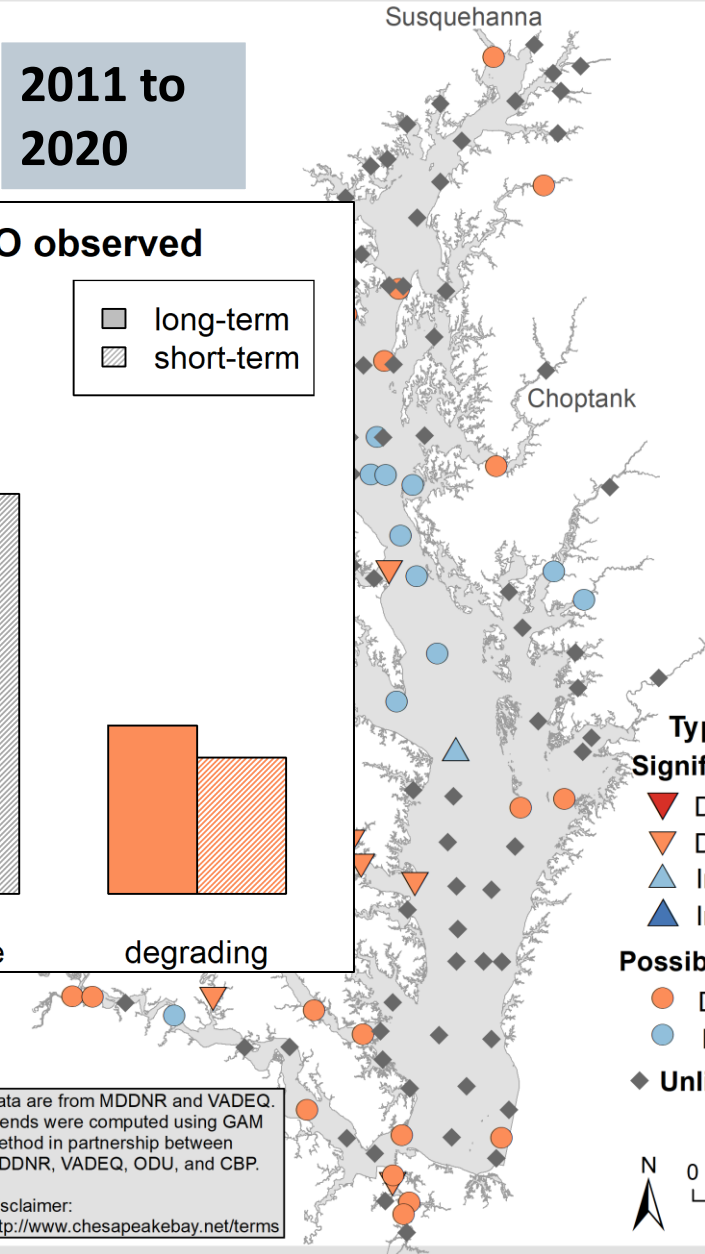


- Decrease
- Increase
- ◆ Unlikely ($p > 0.25$)

Chesapeake Bay Bottom Dissolved Oxygen: June-Sept 2011-2020 change

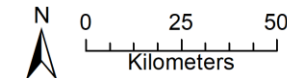


2011 to
2020



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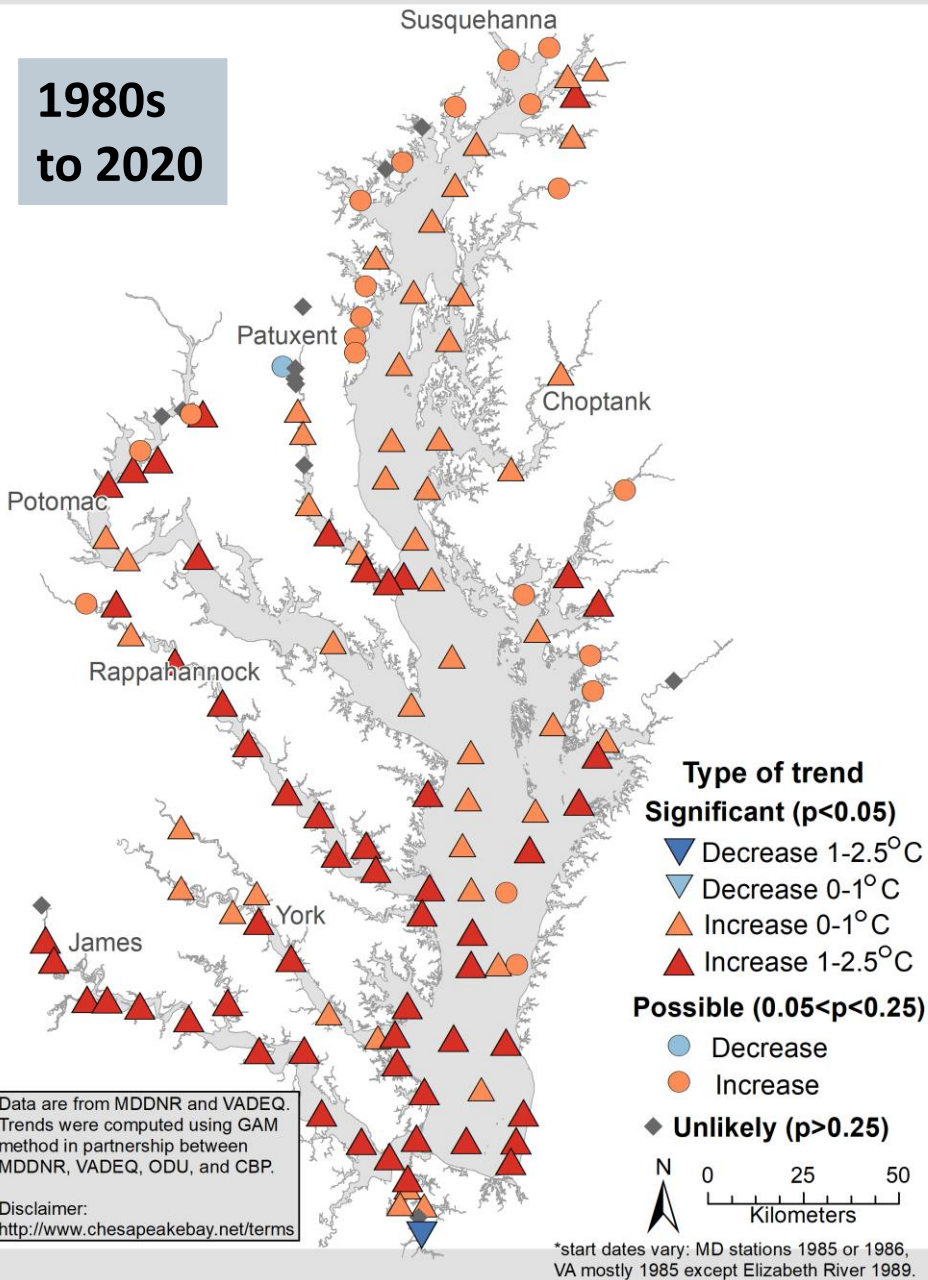
- Type of trend**
- Significant ($p < 0.05$)**
- ▼ Decrease $> 50\%$
 - ▽ Decrease $0-50\%$
 - ▲ Increase $0-50\%$
 - ▲ Increase $> 50\%$
- Possible ($0.05 < p < 0.25$)**
- Decrease
 - Increase
 - ◆ Unlikely ($p > 0.25$)

Temp

Chesapeake Bay Surface Water Temperature: 2020 long-term change*



1980s
to 2020

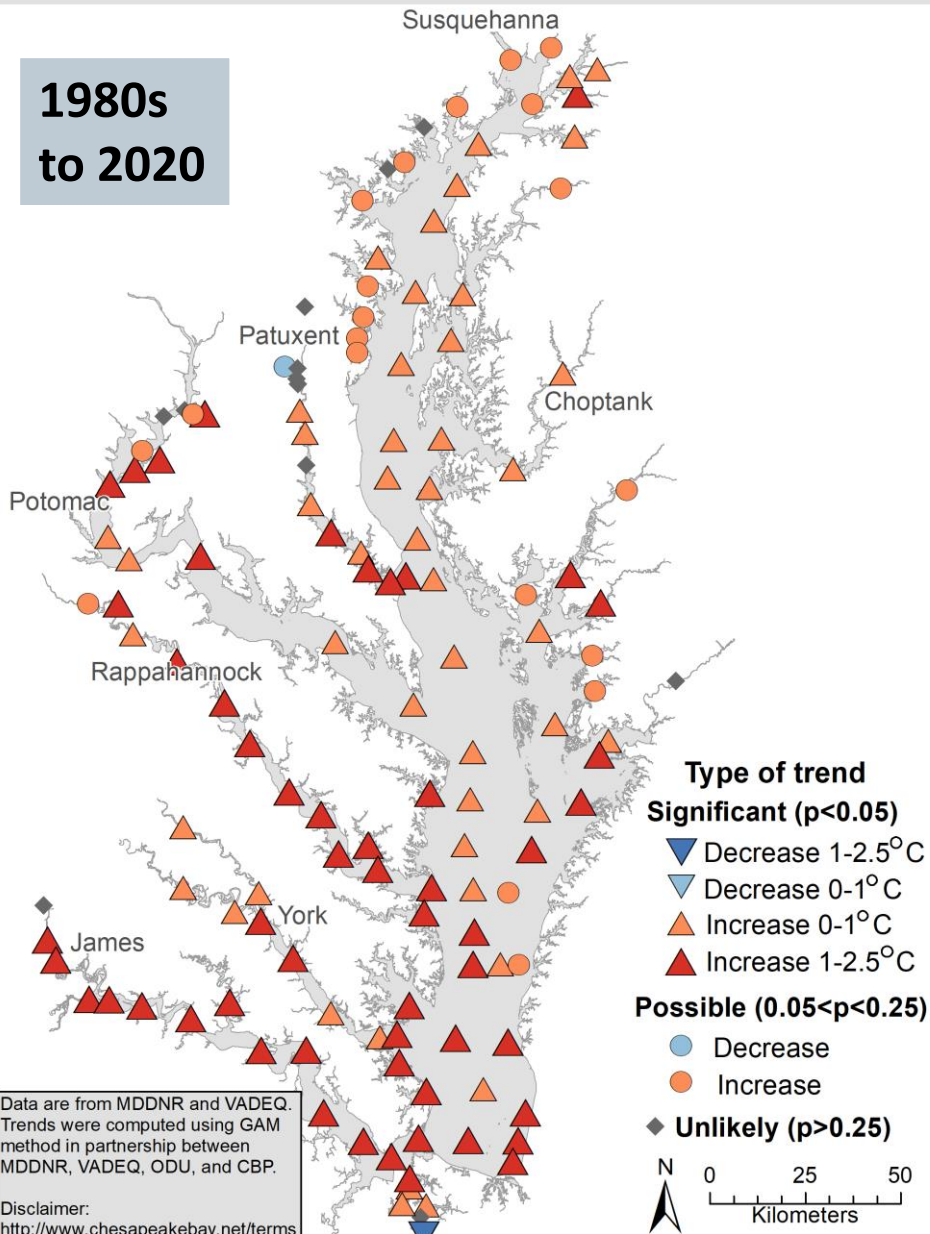


Temp

Chesapeake Bay Surface Water Temperature: 2020 long-term change*



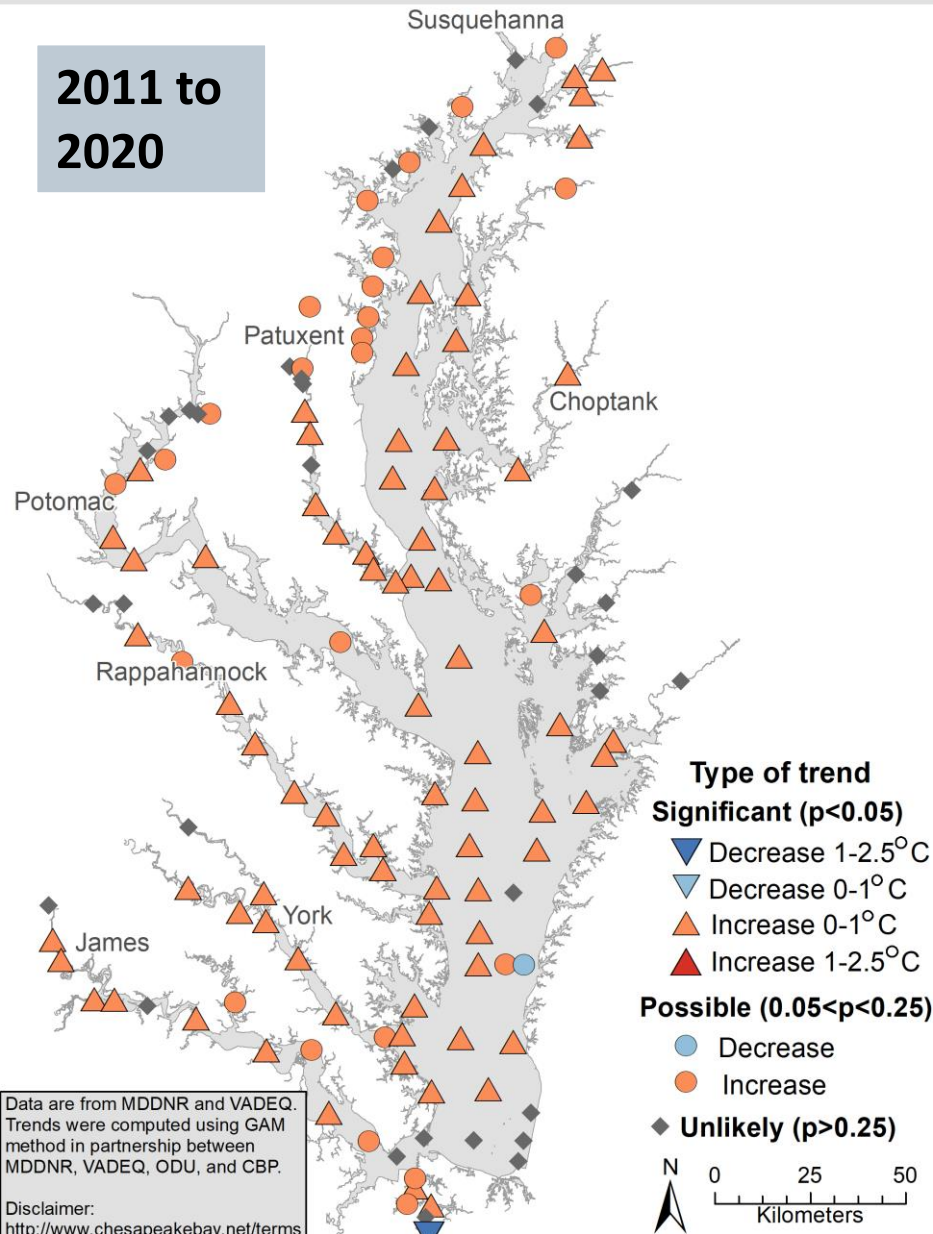
1980s
to 2020



Chesapeake Bay Surface Water Temperature: 2011-2020 change



2011 to
2020

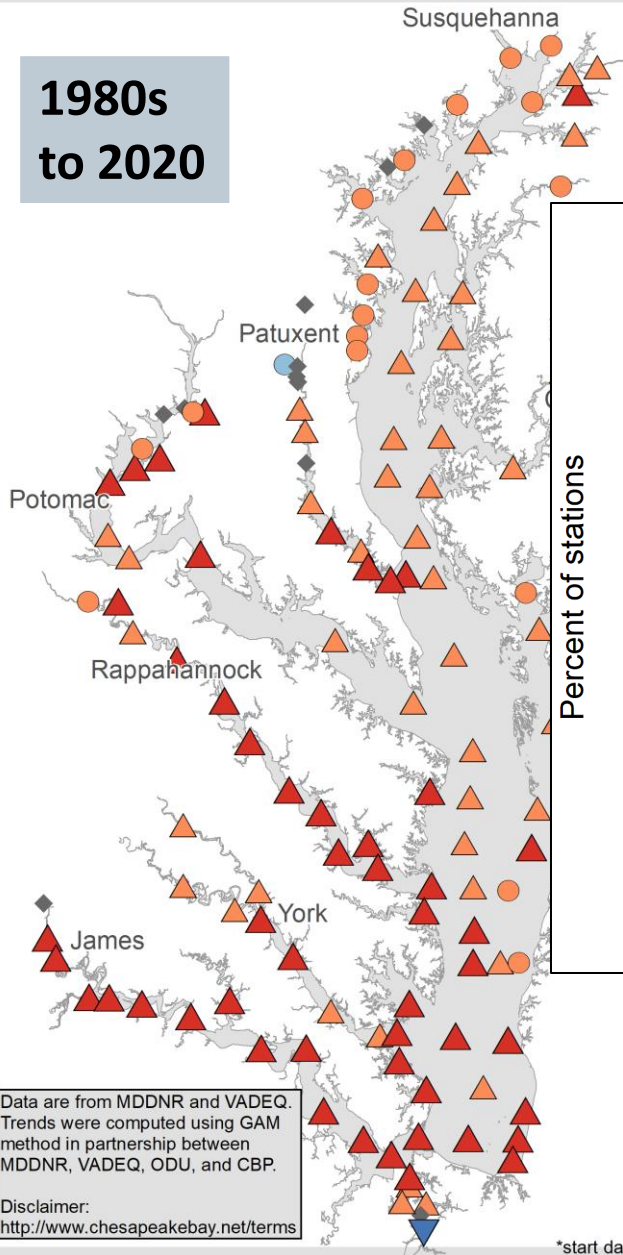


Temp

Chesapeake Bay Surface Water Temperature: 2020 long-term change*



1980s
to 2020



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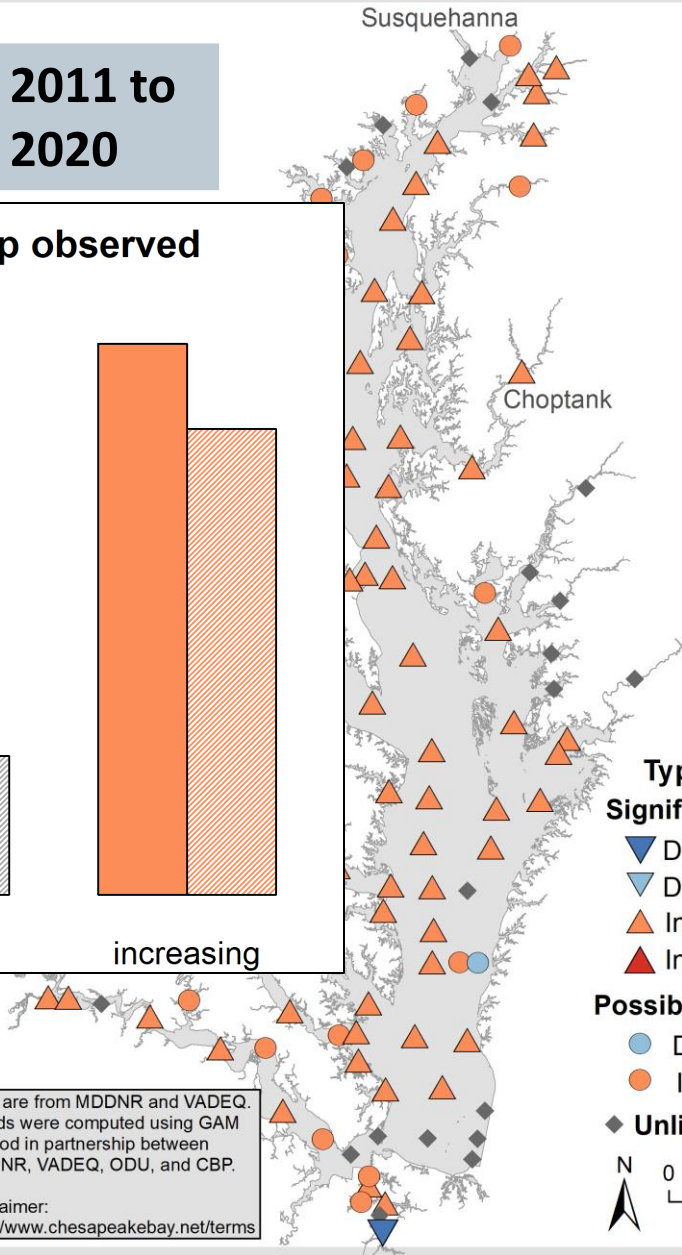
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*start dates vary: MD stations 1985 or 1986, VA mostly 1985 except Elizabeth River 1989.

Chesapeake Bay Surface Water Temperature: 2011-2020 change



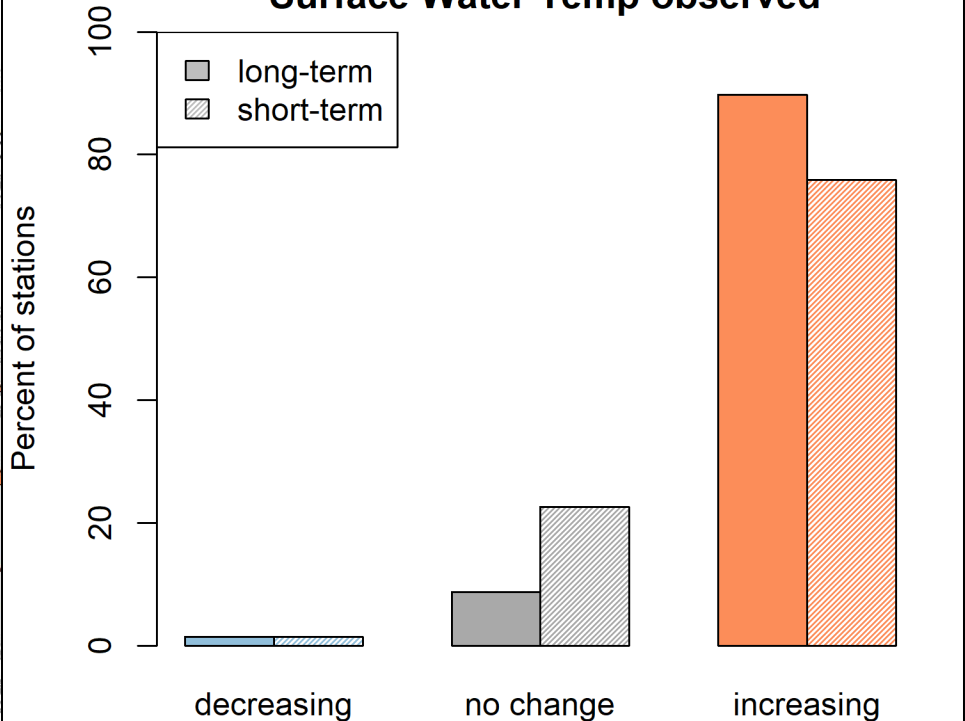
2011 to
2020



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Surface Water Temp observed



Type of trend

Significant ($p < 0.05$)

- Decrease 1-2.5°C
- Decrease 0-1°C
- Increase 0-1°C
- Increase 1-2.5°C

Possible ($0.05 < p < 0.25$)

- Decrease
- Increase

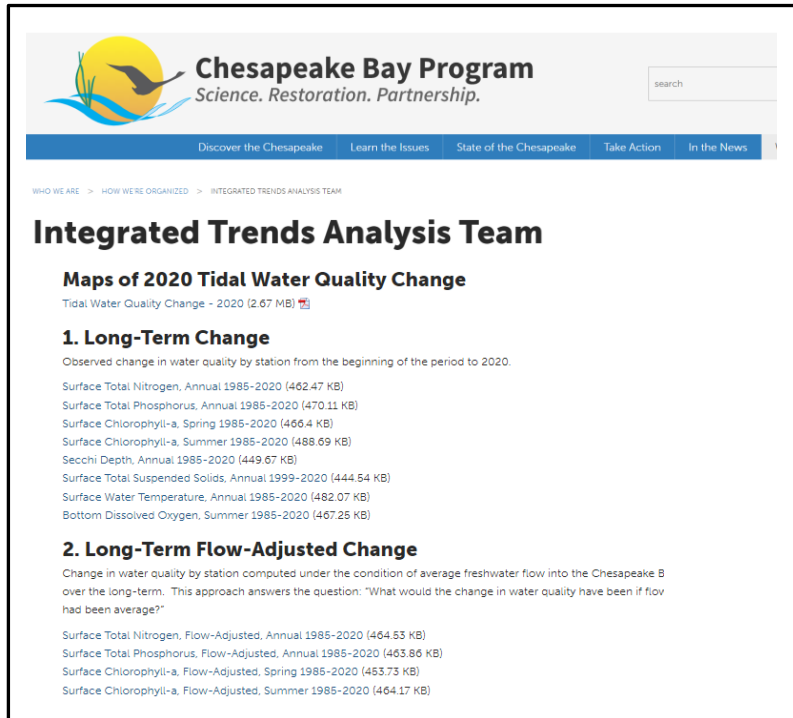
Unlikely ($p > 0.25$)

- Decrease
- Increase

Accessing the results

ITAT webpage:

Static maps and summary document



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WHO WE ARE > HOW WE'RE ORGANIZED > INTEGRATED TRENDS ANALYSIS TEAM

Integrated Trends Analysis Team

Maps of 2020 Tidal Water Quality Change

Tidal Water Quality Change - 2020 (2.67 MB)

1. Long-Term Change

Observed change in water quality by station from the beginning of the period to 2020.

- 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)
- Bottom Dissolved Oxygen, Summer 1985-2020 (467.25 KB)

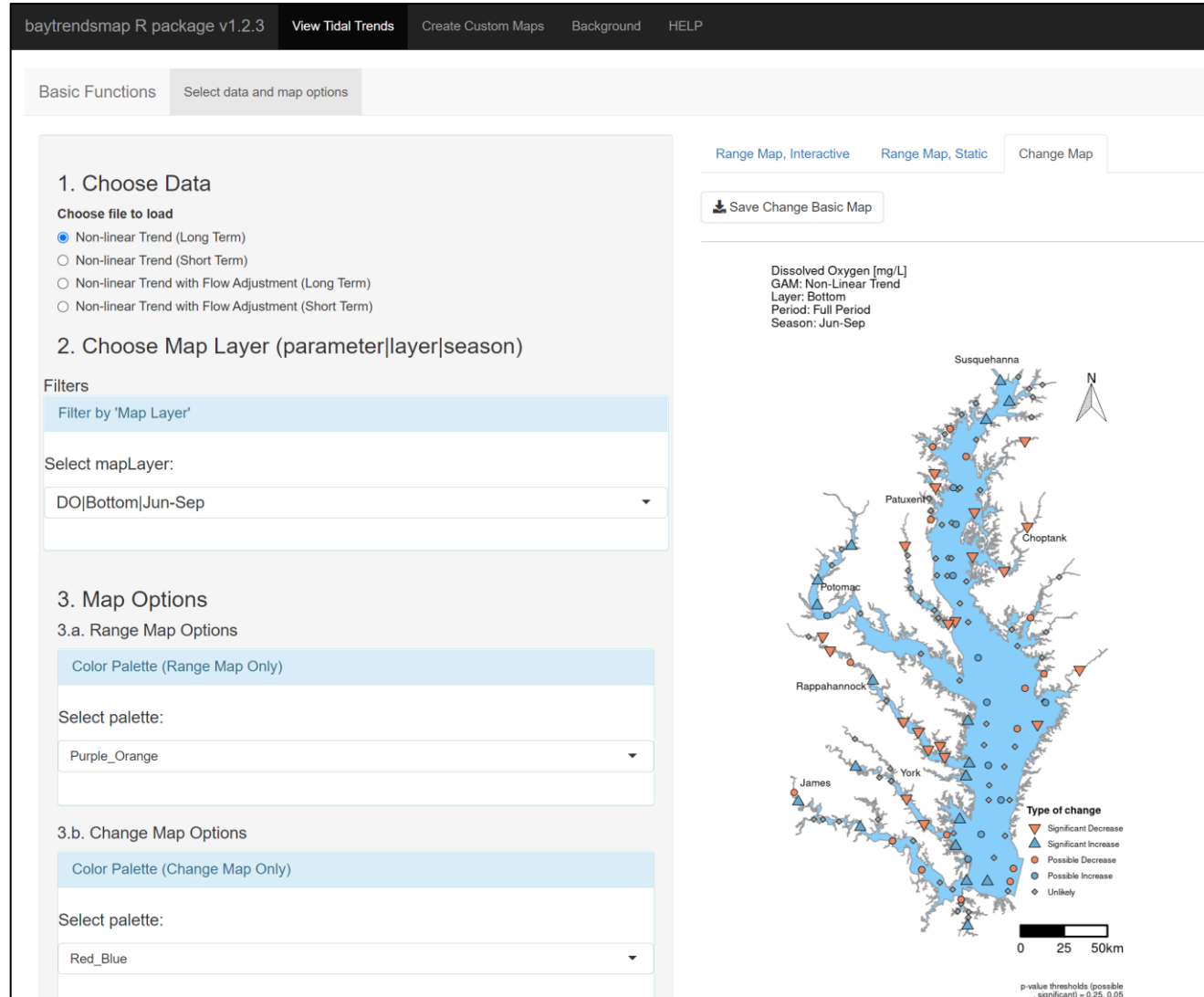
2. Long-Term Flow-Adjusted Change

Change in water quality by station computed under the condition of average freshwater flow into the Chesapeake B over the long-term. This approach answers the question: "What would the change in water quality have been if flow had been average?"

- Surface Total Nitrogen, Flow-Adjusted, Annual 1985-2020 (464.53 KB)
- Surface Total Phosphorus, Flow-Adjusted, Annual 1985-2020 (463.86 KB)
- Surface Chlorophyll-a, Flow-Adjusted, Spring 1985-2020 (453.73 KB)
- Surface Chlorophyll-a, Flow-Adjusted, Summer 1985-2020 (464.17 KB)

https://www.chesapeakebay.net/who/group/integrated_trends_analysis_team

baytrendsmap app: Web tool to map the trends, current concentrations, and zoom in on regions



baytrendsmap R package v1.2.3 | View Tidal Trends | Create Custom Maps | Background | HELP

Basic Functions | Select data and map options

1. Choose Data

Choose file to load

- ☒ Non-linear Trend (Long Term)
- ☐ Non-linear Trend (Short Term)
- ☐ Non-linear Trend with Flow Adjustment (Long Term)
- ☐ Non-linear Trend with Flow Adjustment (Short Term)

2. Choose Map Layer (parameter|layer|season)

Filters

Filter by 'Map Layer'

Select mapLayer:

DO|Bottom|Jun-Sep

3. Map Options

3.a. Range Map Options

Color Palette (Range Map Only)

Select palette:

Purple_Orange

3.b. Change Map Options

Color Palette (Change Map Only)

Select palette:

Red_Blue

Range Map, Interactive | Range Map, Static | Change Map

Save Change Basic Map

Dissolved Oxygen [mg/L]
GAM: Non-Linear Trend
Layer: Bottom
Period: Full Period
Season: Jun-Sep

Susquehanna
Patuxent
Choptank
Potomac
Rappahannock
York
James

Type of change

- Significant Decrease
- Significant Increase
- Possible Decrease
- Possible Increase
- Unlikely

0 25 50km

p-value thresholds (possible significant) = 0.25, 0.05

<https://baytrends.chesapeakebay.net/baytrendsmap/>

Accessing the results

baytrendsmap app: Web tool to map the trends, current concentrations, and zoom in on regions

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Basic Functions Select data and map options

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3. Map Options

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Select palette:

Purple_Orange

3.b. Change Map Options

Color Palette (Change Map Only)

Select palette:

Red_Blue

Range Map, Interactive Range Map, Static Change Map

Save Change Basic Map

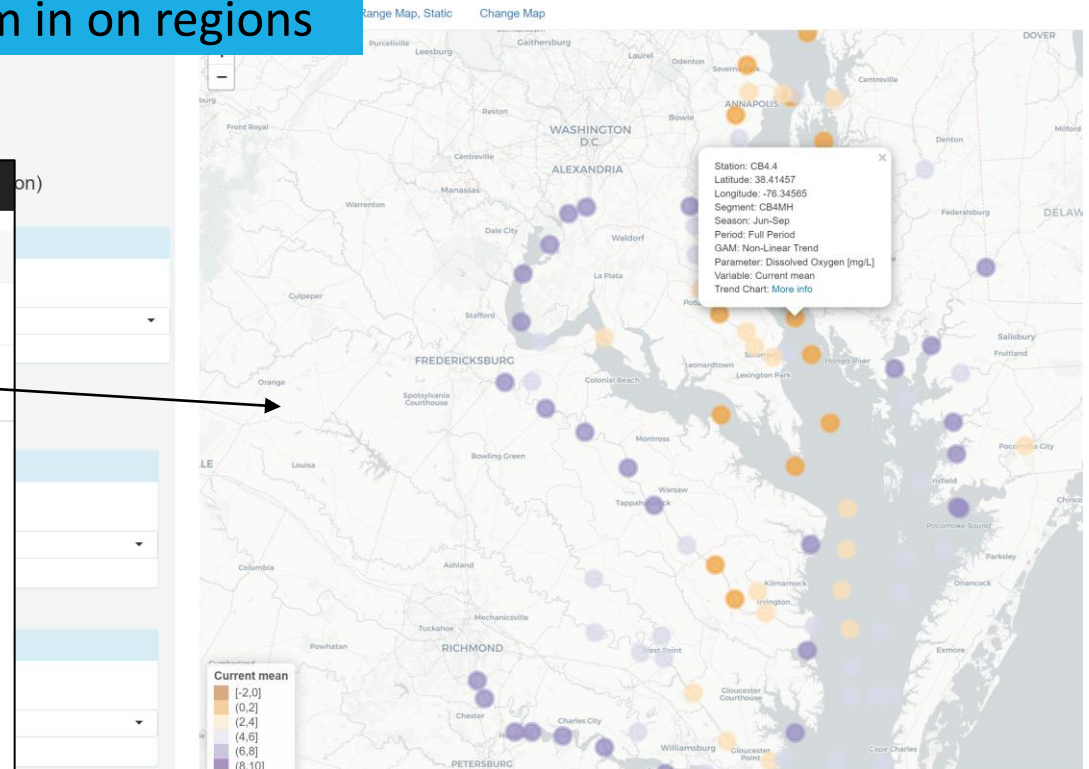
Dissolved Oxygen [mg/L]
GAM: Non-Linear Trend
Layer: Bottom
Period: Full Period
Season: Jun-Sep

Type of change

- Significant Decrease
- Significant Increase
- Possible Decrease
- Possible Increase
- Unlikely

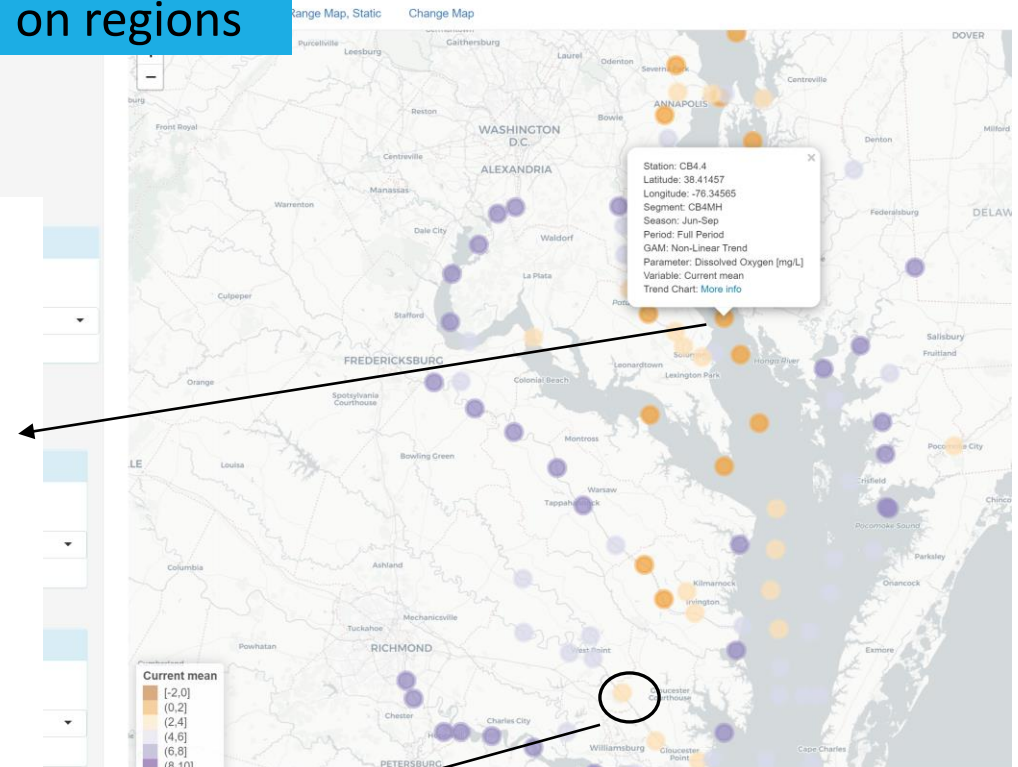
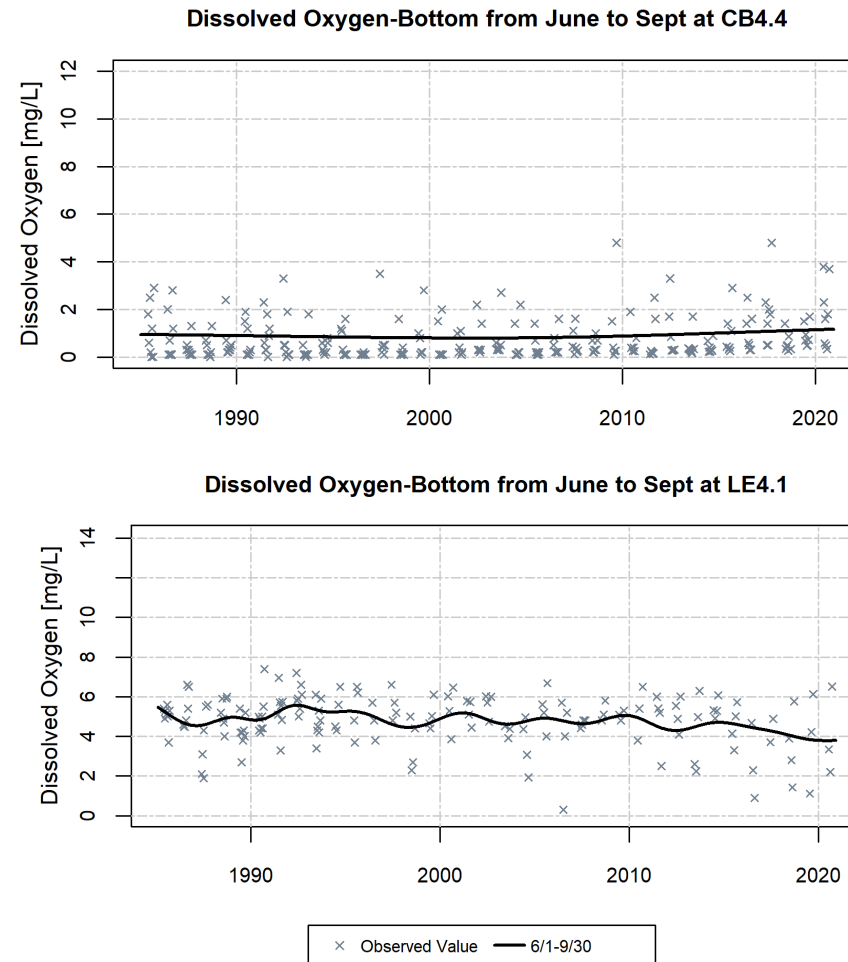
0 25 50km

p-value thresholds (possible significant) = 0.05, 0.05



Accessing the results

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Next steps and Team

- 2021 Tidal Trends will be released by November
 - Very likely to be included this year: 18 Washington DC stations in Potomac and Anacostia for some parameters
- Update tributary summaries with the new trends (next presentation)

Tidal Trends collaborators:

- CBP office: Breck Sullivan (USGS), Vanessa Van Note (EPA), Rebecca Murphy (UMCES, rmurphy@chesapeakebay.net)
- States & DC: Renee Karrh (MDDNR), Mike Lane (ODU), Cindy Johnson (VADEQ), Efeturi Oghenekaro, Blessing Edje and George Onyullo (DOEE), Mukhtar Ibrahim and Karl Berger (COG)
- Consultants: Elgin Perry (independent), Jon Harcum and Erik Leppo (Tetra Tech)