Chesapeake Bay Tidal Trends Update

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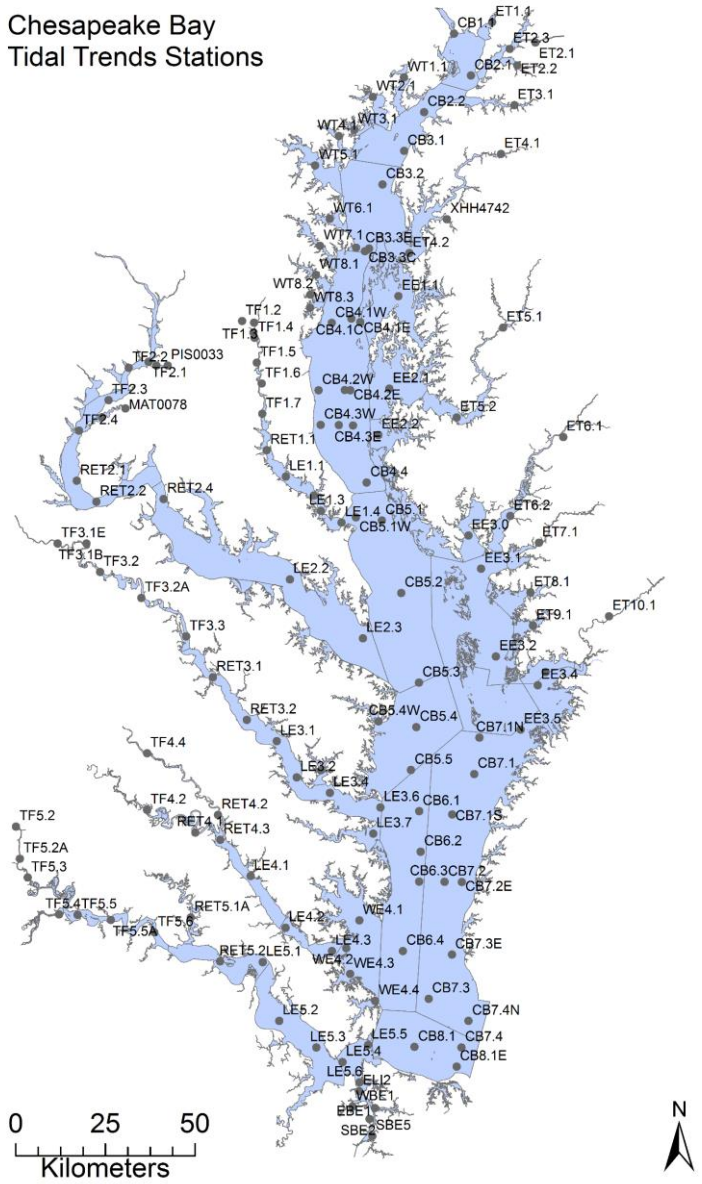
Integrated Trends Analysis Team lead: ***Jeni Keisman*** *(USGS)*
Trends run by ***Renee Karrh*** *(MDDNR) and* ***Mike Lane*** *(ODU)*

STAR

May 27, 2021

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Chesapeake Bay Program
Science. Restoration. Partnership.



Extensive long-term coordinated tidal 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 at multiple depths
- Long-standing coordinated effort to analyze trends in these data between the partners

Matt Rath/Chesapeake Bay Program

Annual tidal trends/ change production

Tidal data

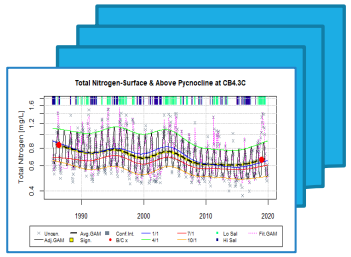
(Full set in spring for previous year)

For MD: Renee Karrh (MDDNR)

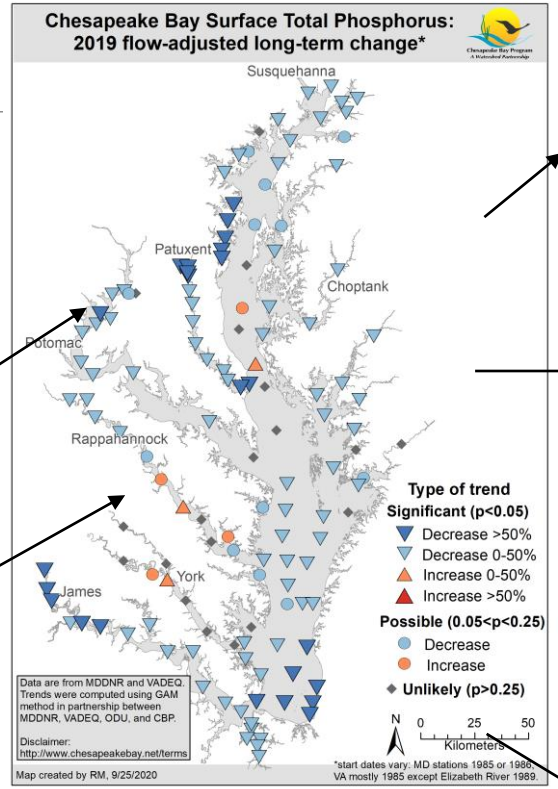
For VA: Mike Lane (ODU for VADEQ)

'baytrends' R package to run analysis

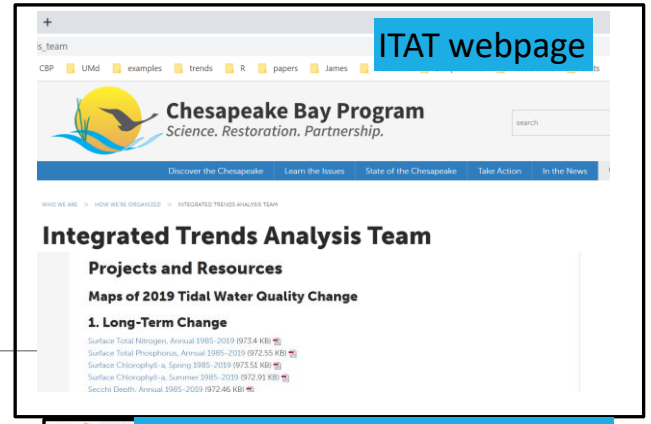
Development by: Jon Harcum, Erik Leppo (Tetra Tech); Elgin Perry (consultant); Jeni Keisman (USGS) Rebecca Murphy (UMCES)

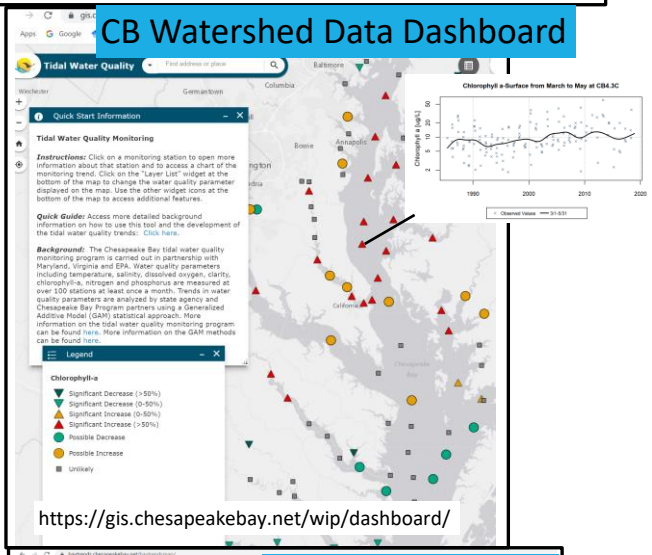


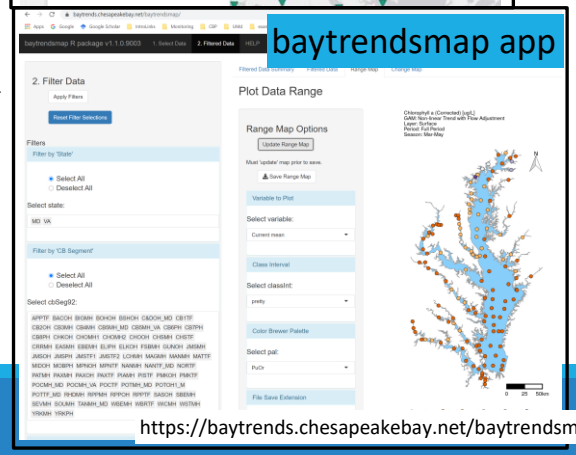
Submitted to CBP & combined *(June)*



(Made available during the fall, for previous year)







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
- Capture the spatial and temporal dynamics:
  - Surface & bottom
  - Observed 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

Applicable to many of the outcomes:

- Fisheries and habitat
- SAV
- Water quality standards
- Climate change

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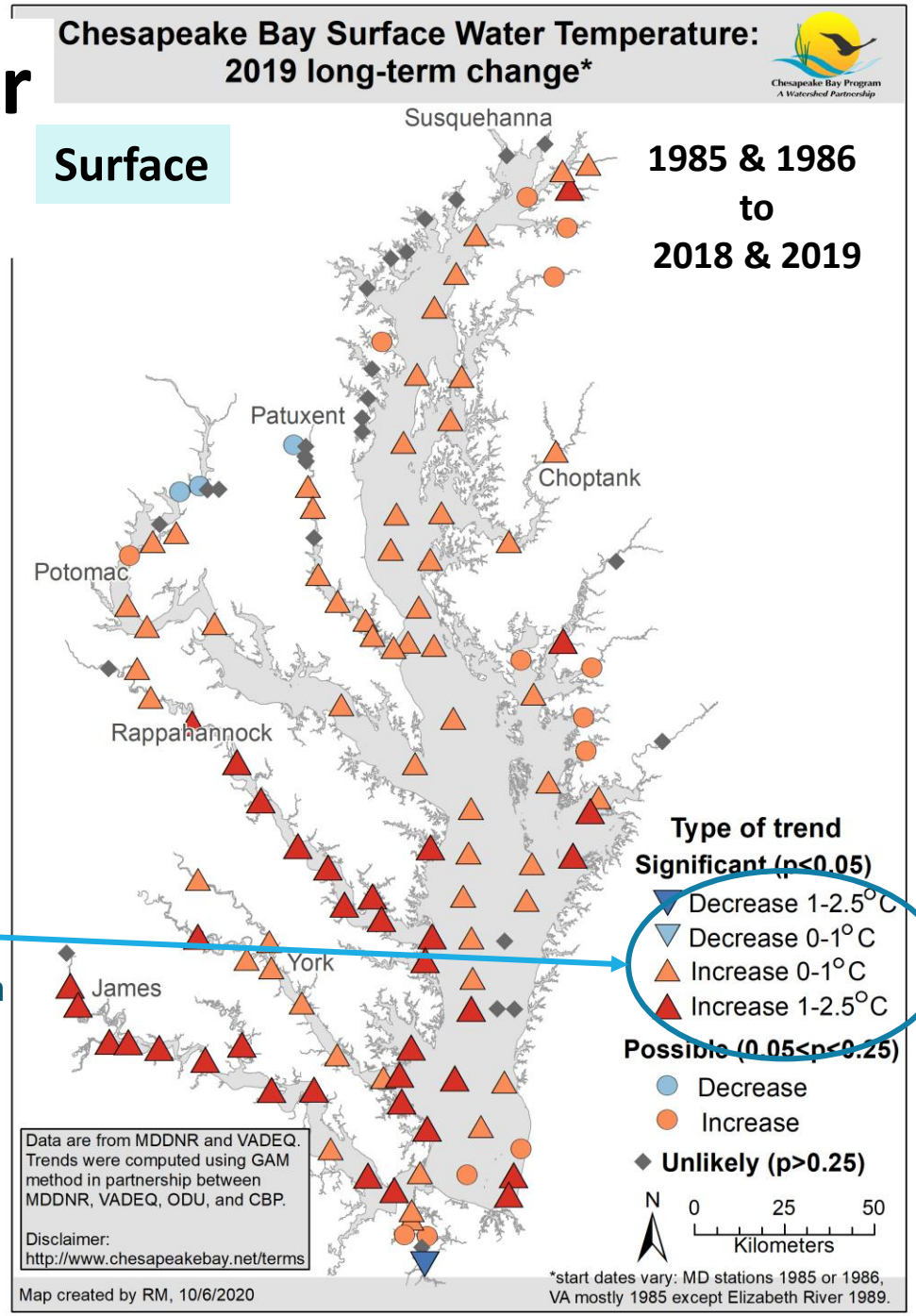
Water temperature

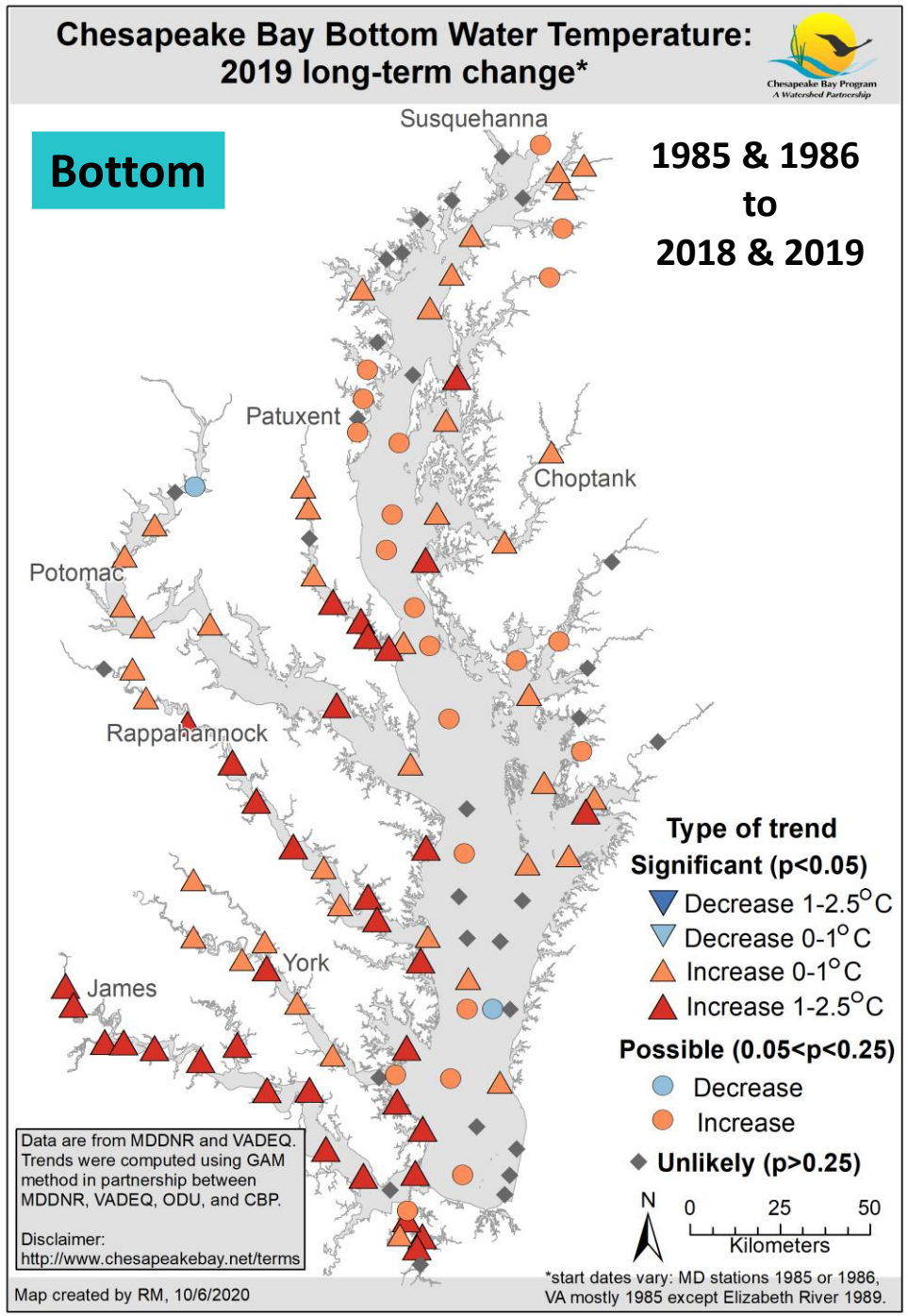
Water temp

long-term



These are for the 34 years.

Per year, median surface increase = 0.024 C

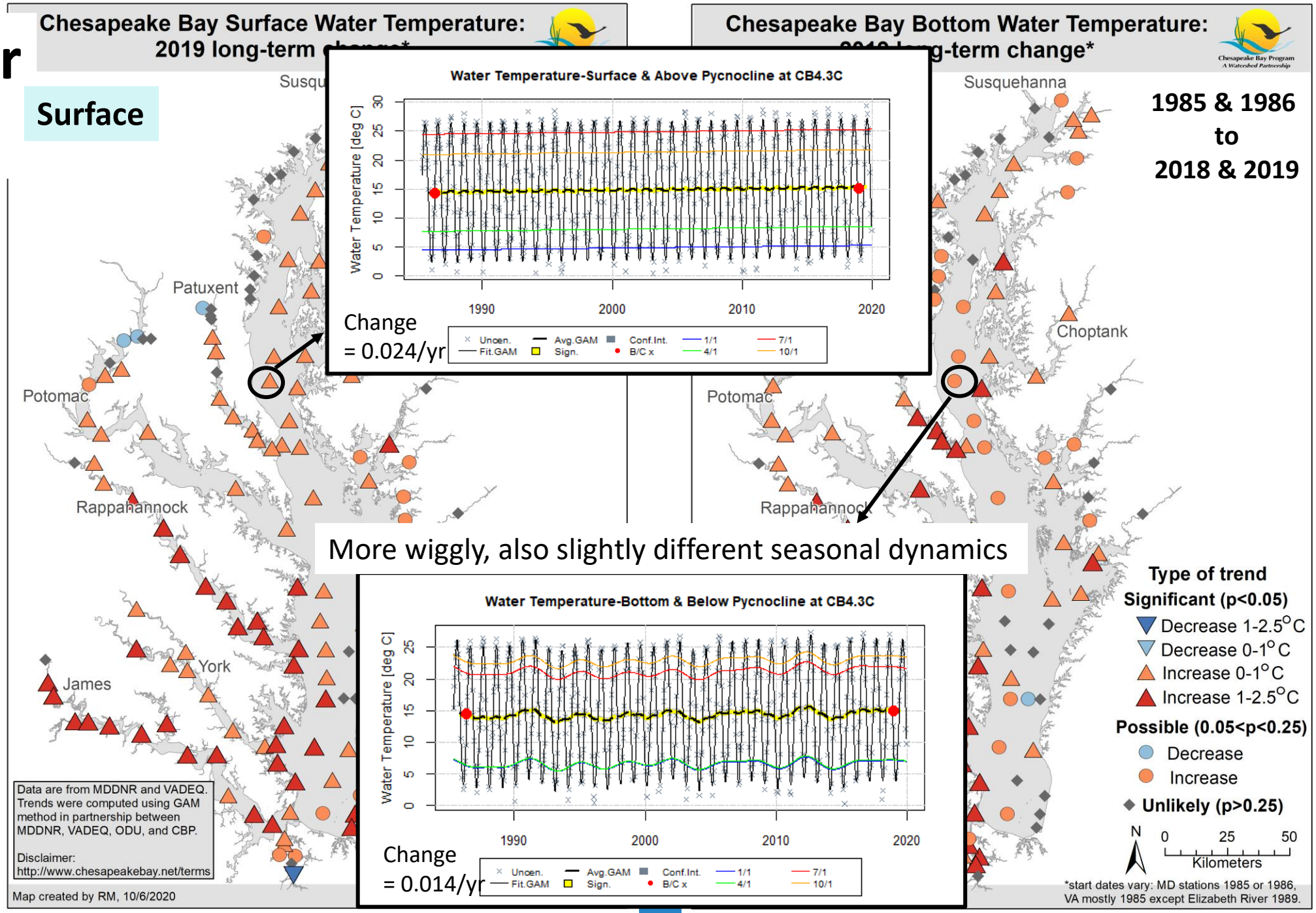


Water temp

long-term

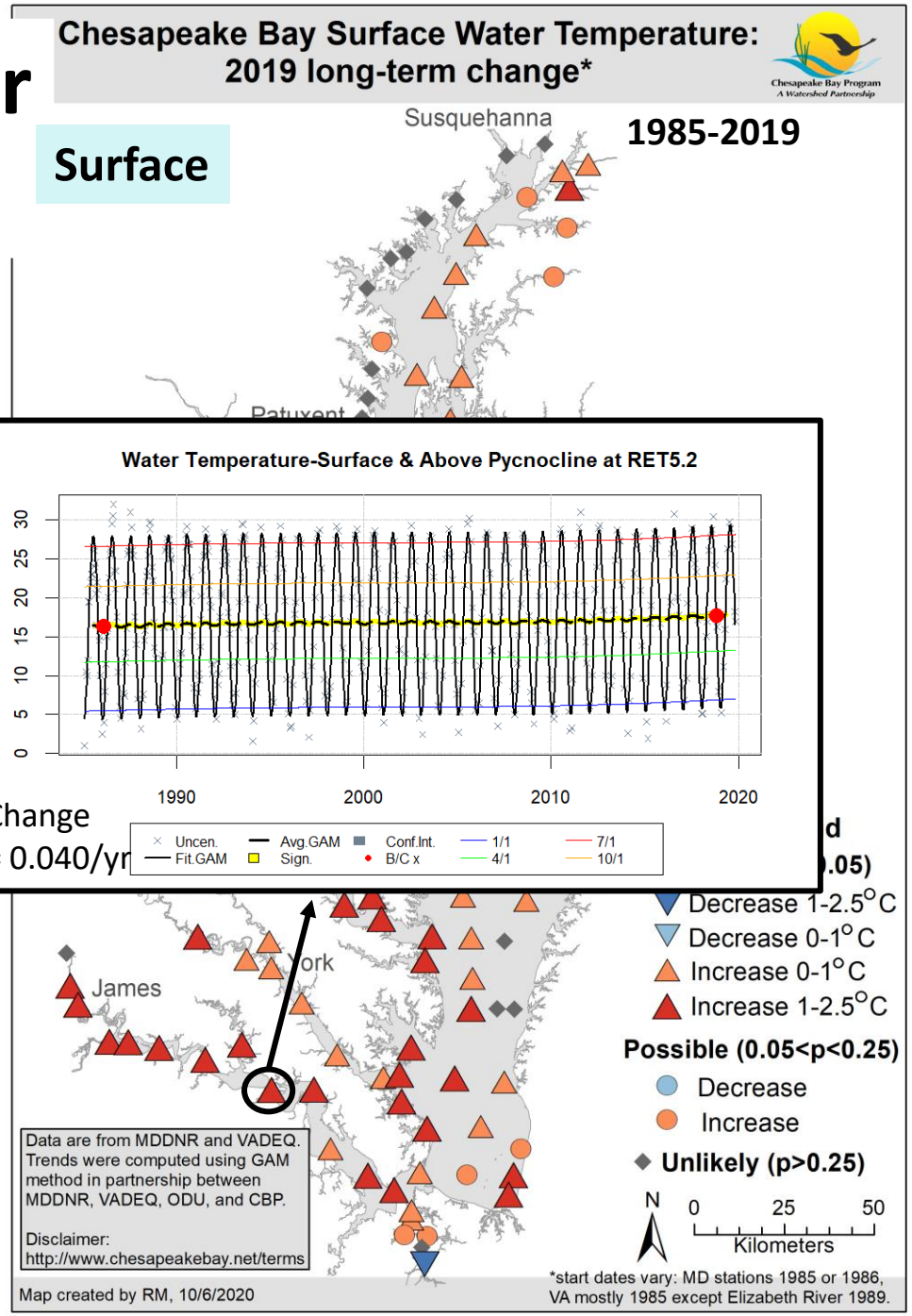
Surface

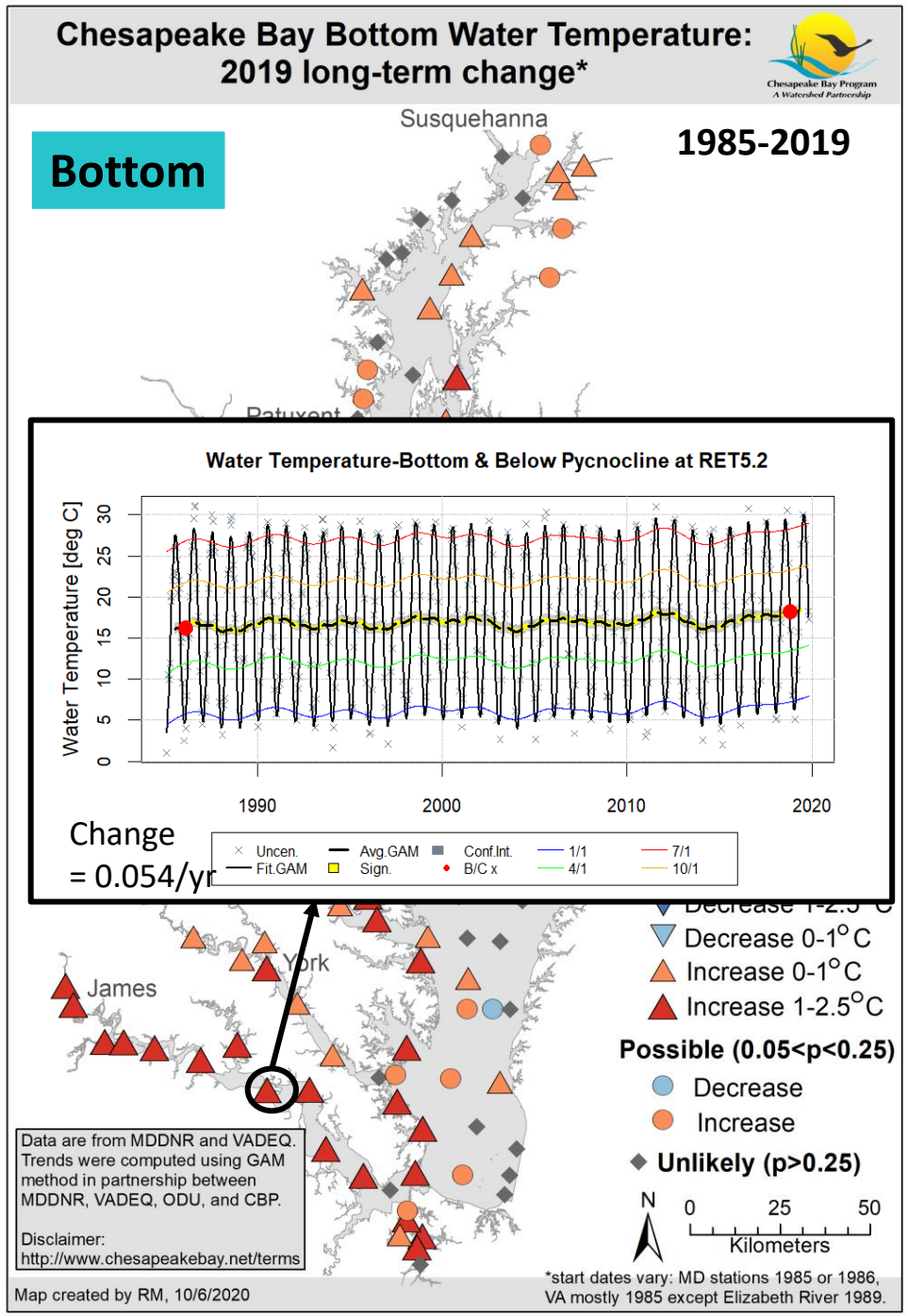
Example surface change larger



Water temp

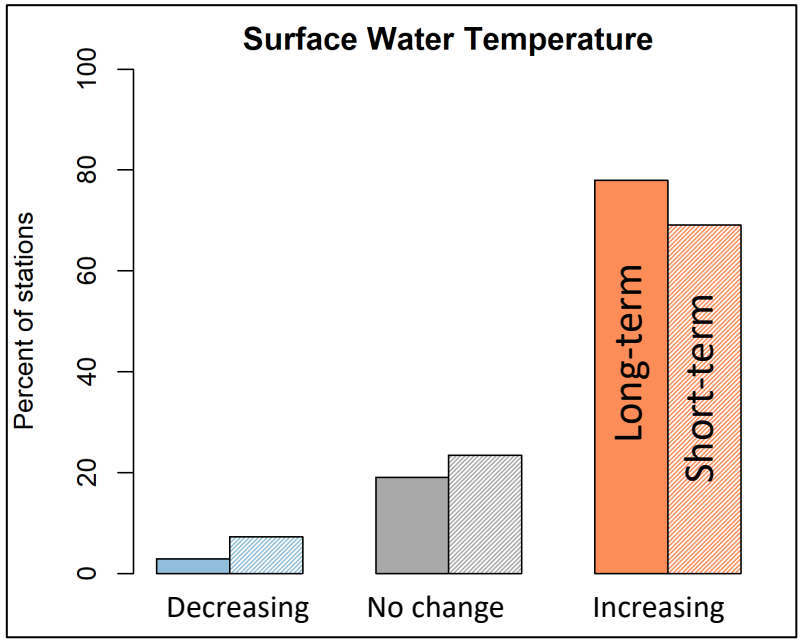
long-term

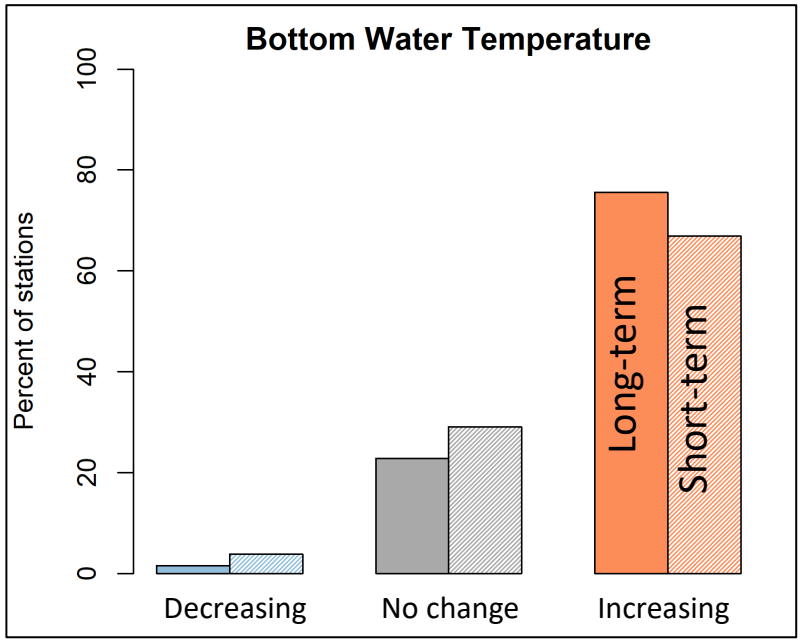




Example bottom change larger

Water temperature trend summary



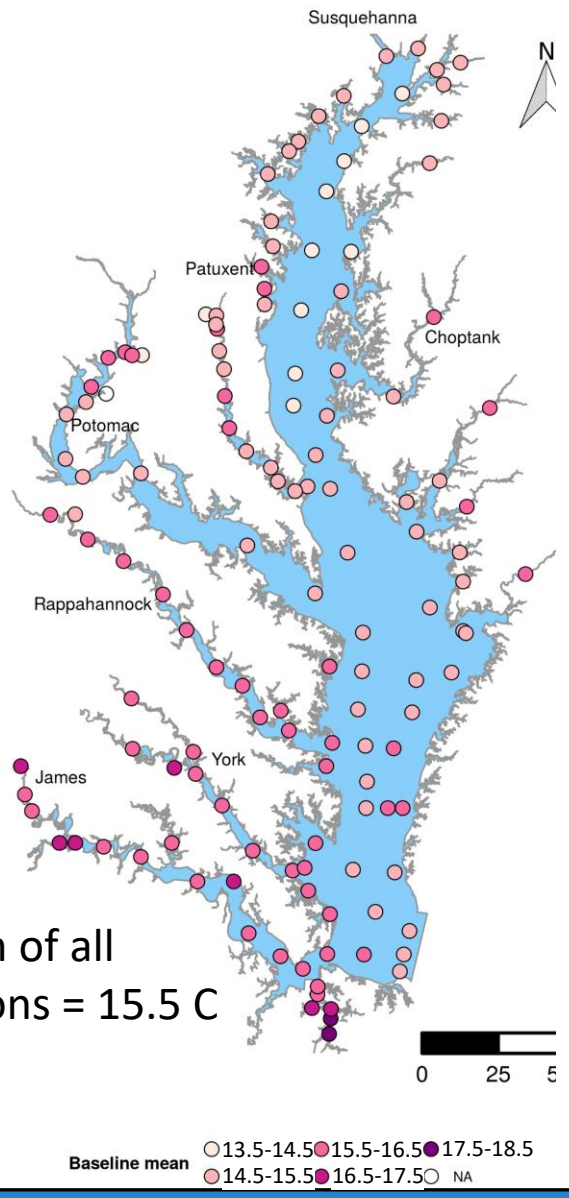


Other output possibly useful

- Can specify any period to generate an estimate of the mean for those dates
- These are annual, but could be output for a certain season
- Could combine these into baywide or regional averages, annual or certain season.

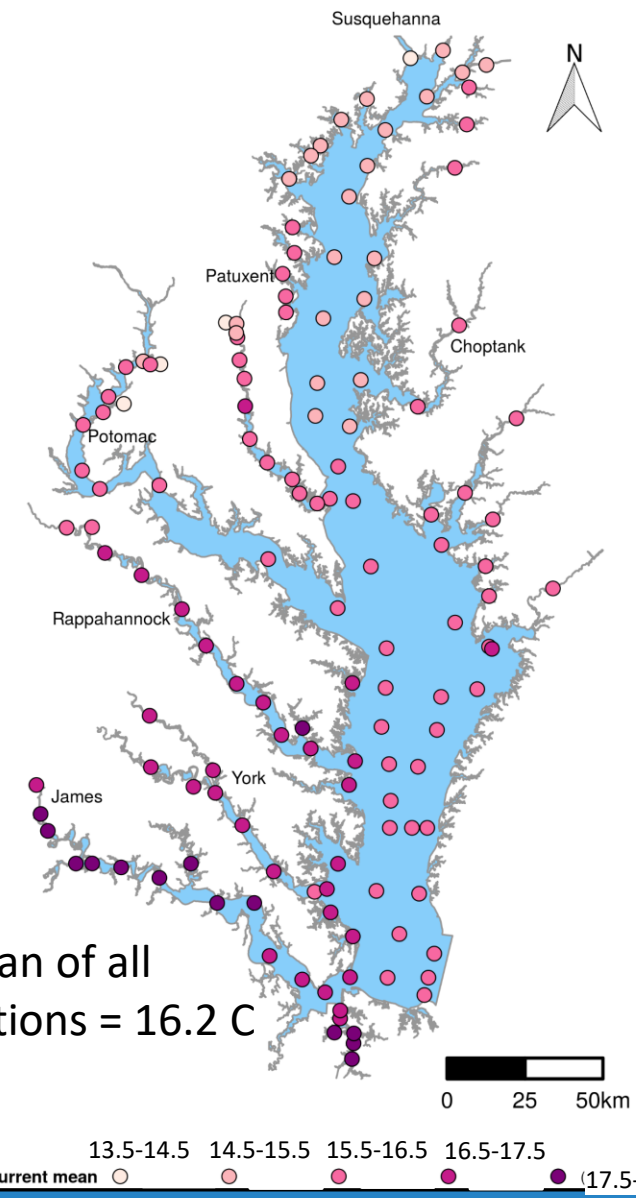
https://baytrends.chesapeakebay.net/baytrendsmap/

Surface water temp 1985-1986 mean



Mean of all Stations = 15.5 C

Surface water temp 2018-2019 mean

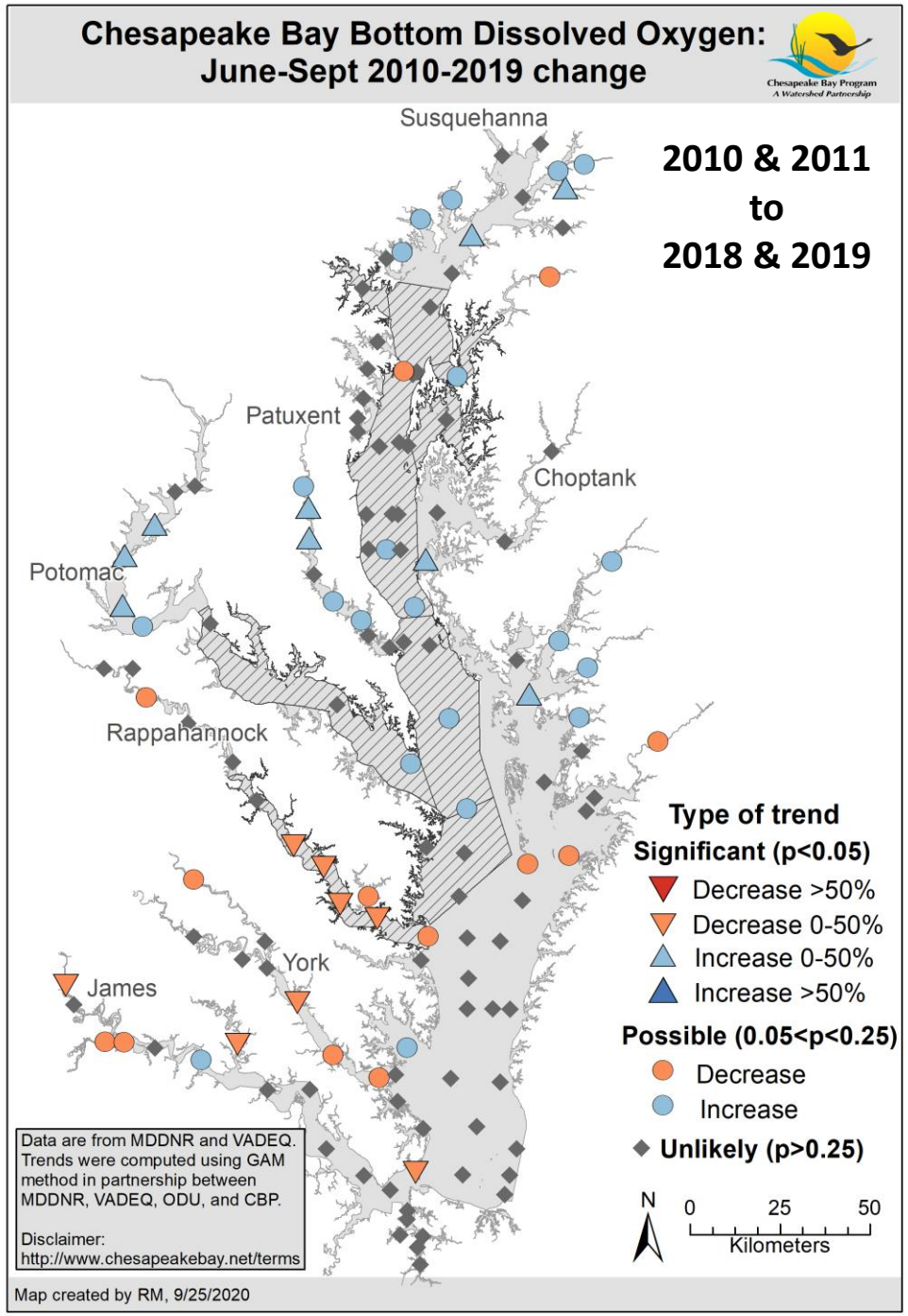


Mean of all Stations = 16.2 C

Summer Bottom Dissolved Oxygen

Summer Bottom DO

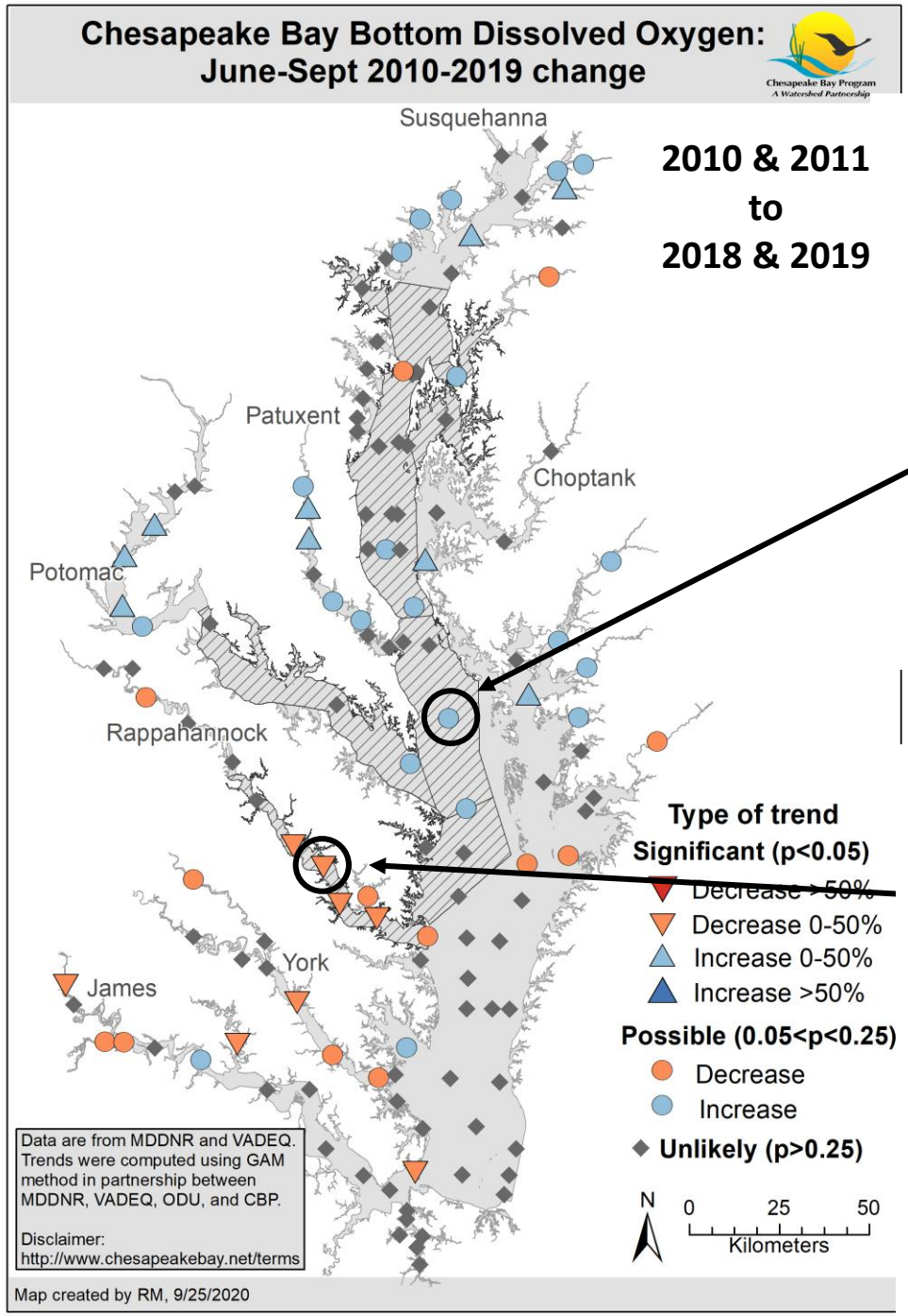
short-term



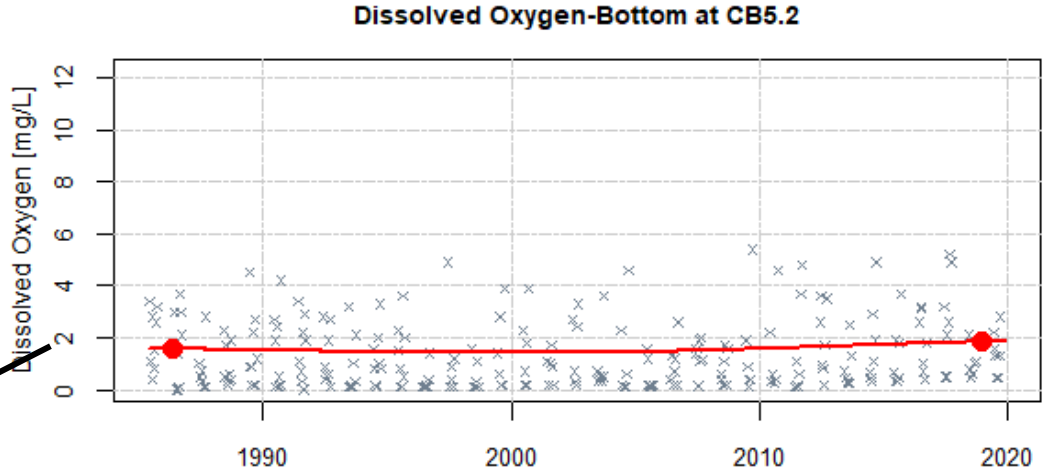
- Depths vary greatly across the tidal waters.
- Very different forces are influential to bottom DO depending on mixing and depth.
- Deep channel segments with the summer criteria 1 mg/L are indicated with hatching.

Summer Bottom DO

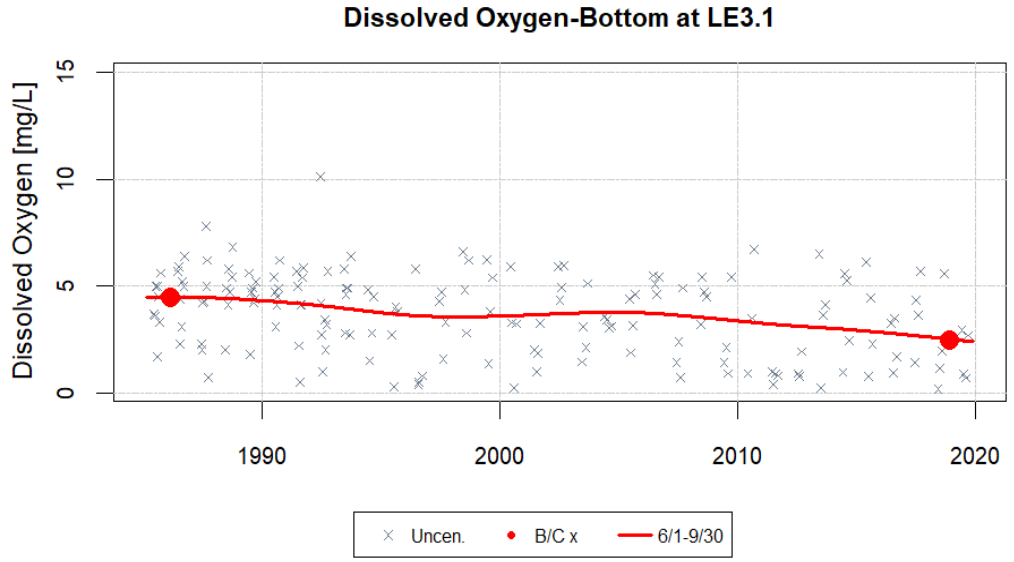
short-term



1. Small, but meaningful DO increase in deep mainstem in last 10 years.

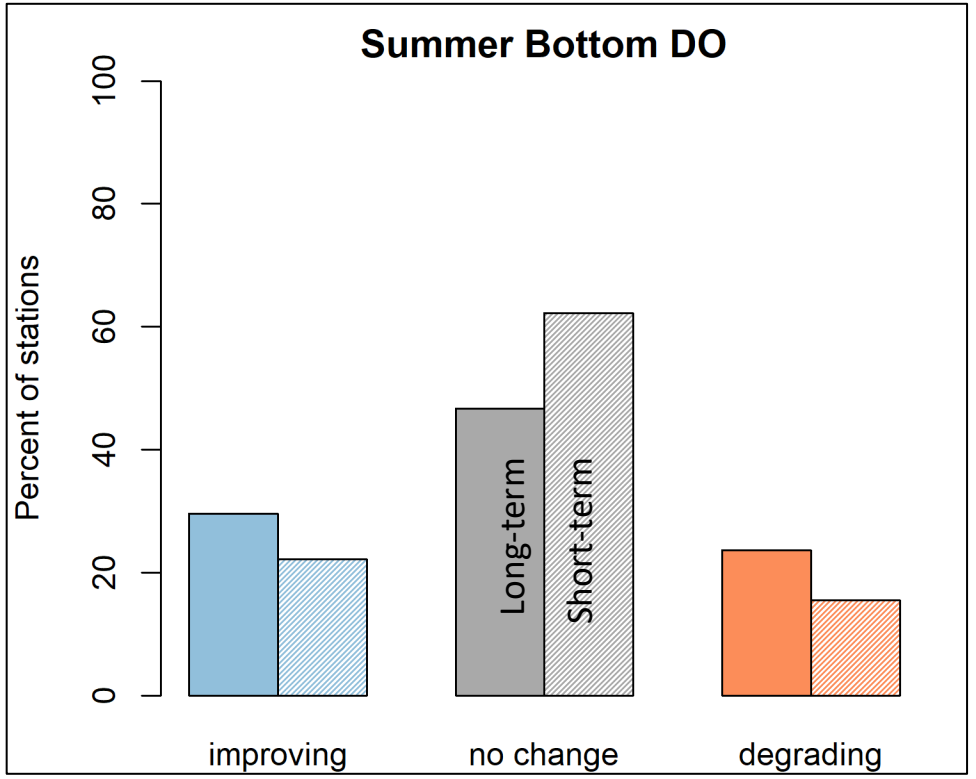


2. Only deep channel segment with degradation is in Rappahannock. Can see it clearly in plots.



DO summary

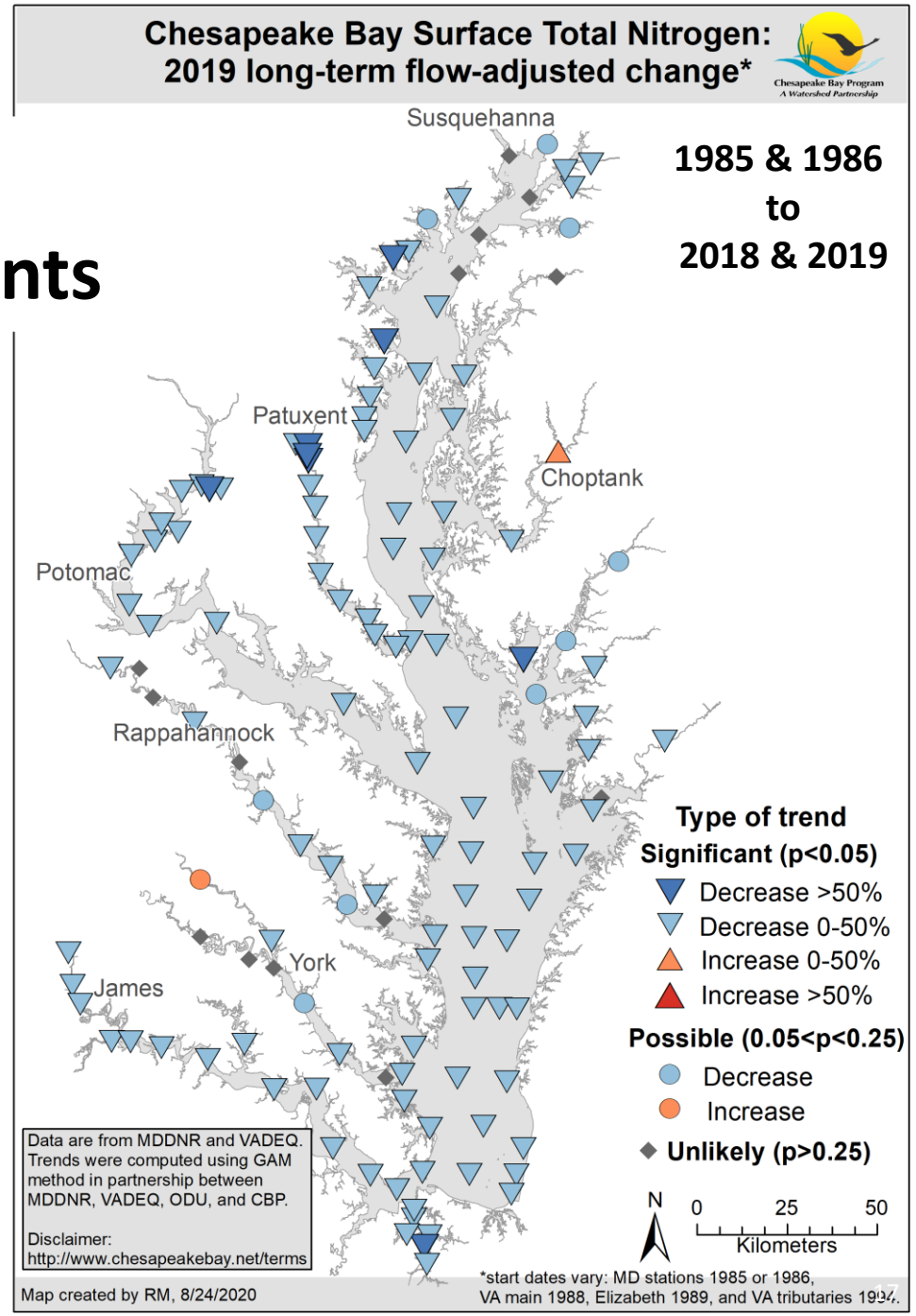
- A wide-variety of DO trends are likely due to different bottom conditions throughout the tidal waters.
- Most stations show no significant change over time.
- Notably, mainstem deep channel stations are slightly improving due to near-zero values not occurring as much anymore.

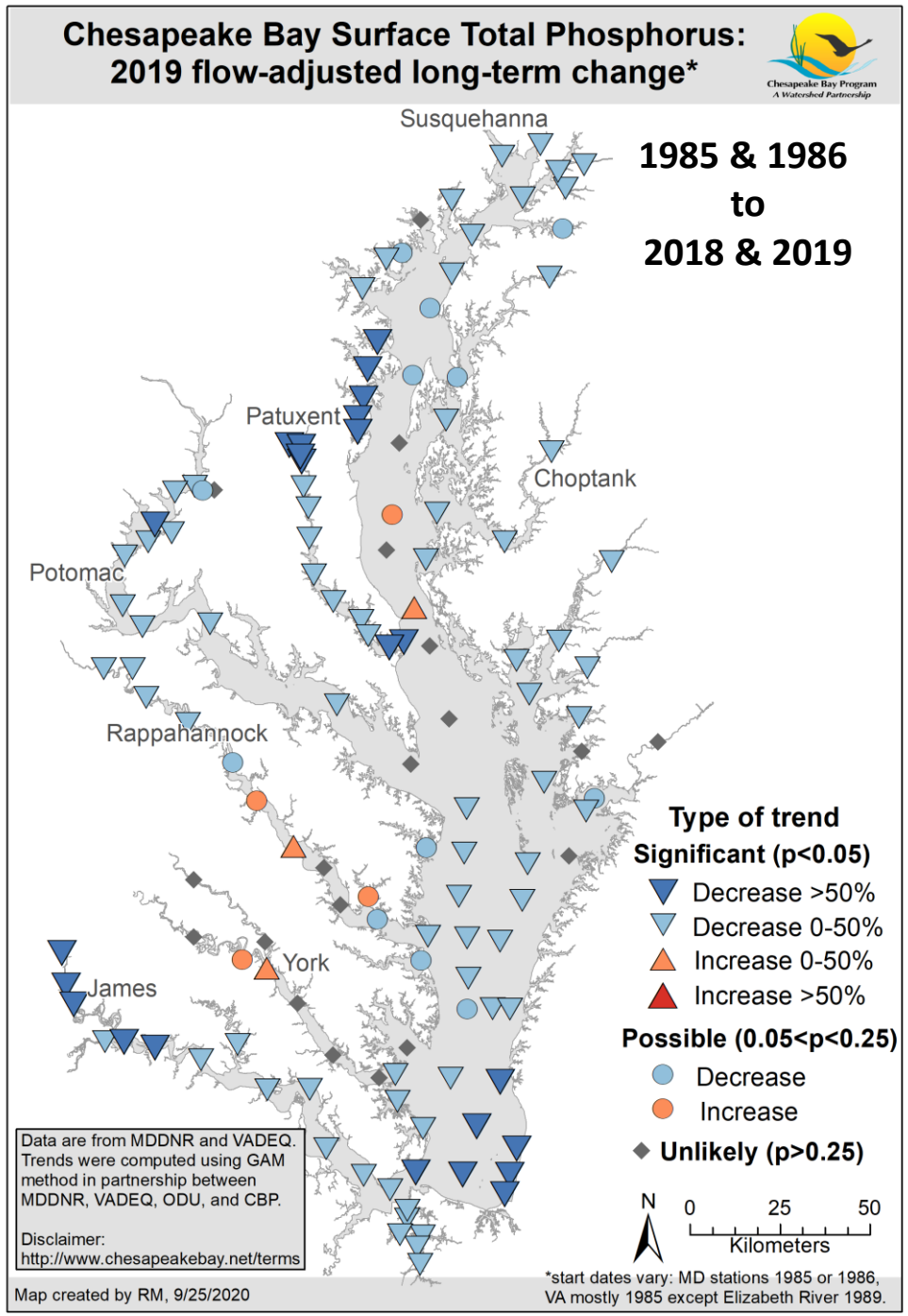


Total Nutrients

Total nutrients

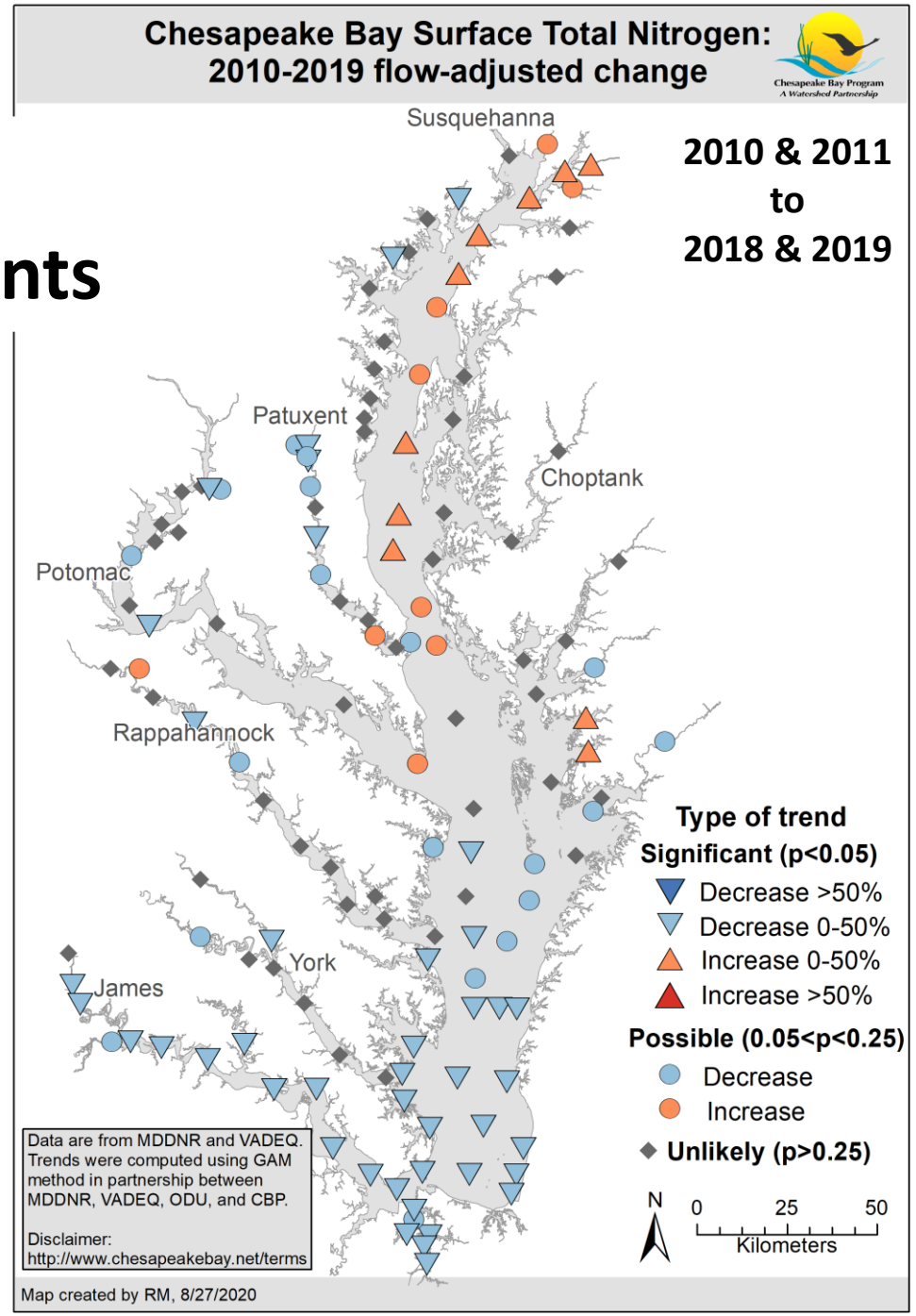
long-term

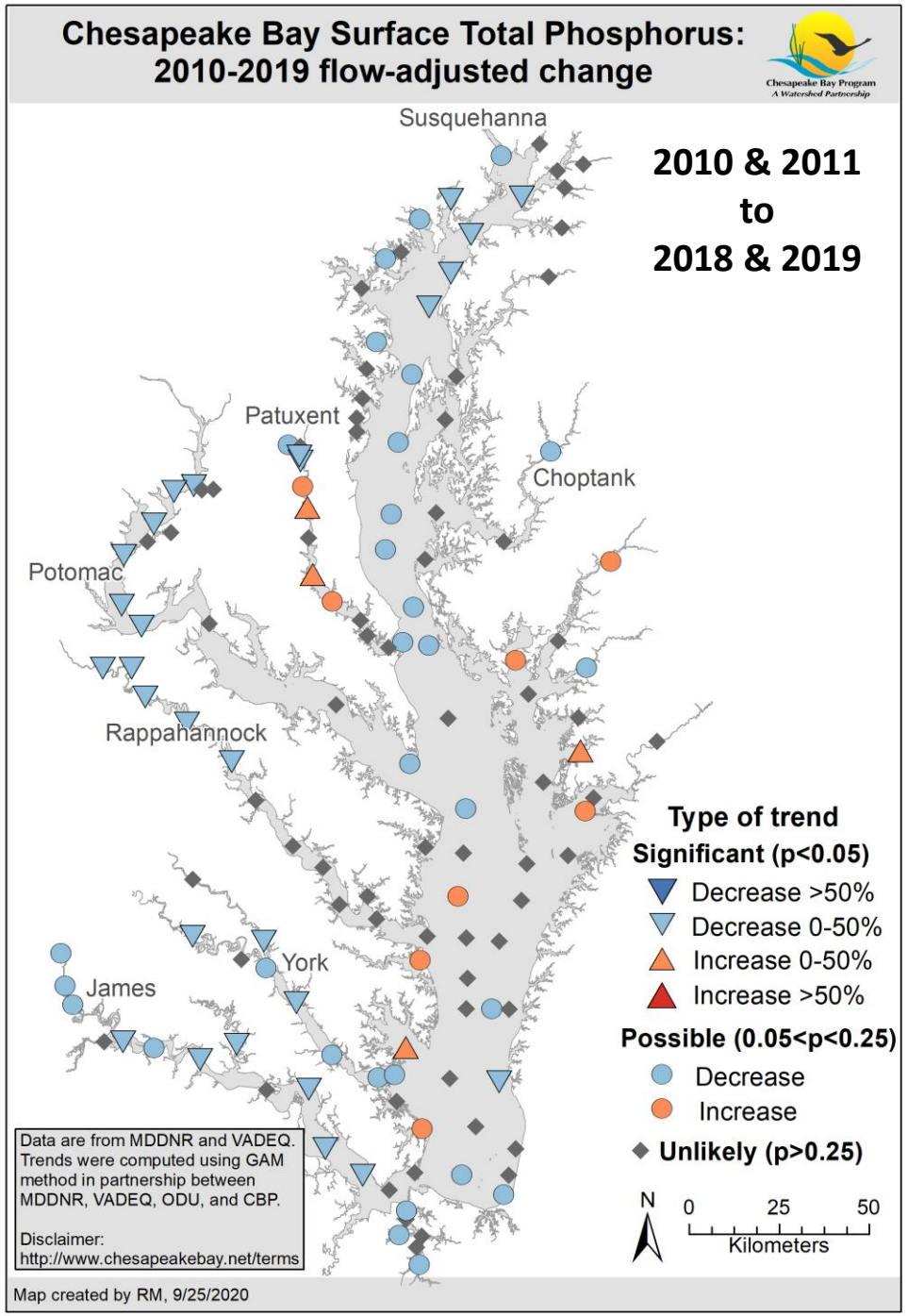




Total nutrients

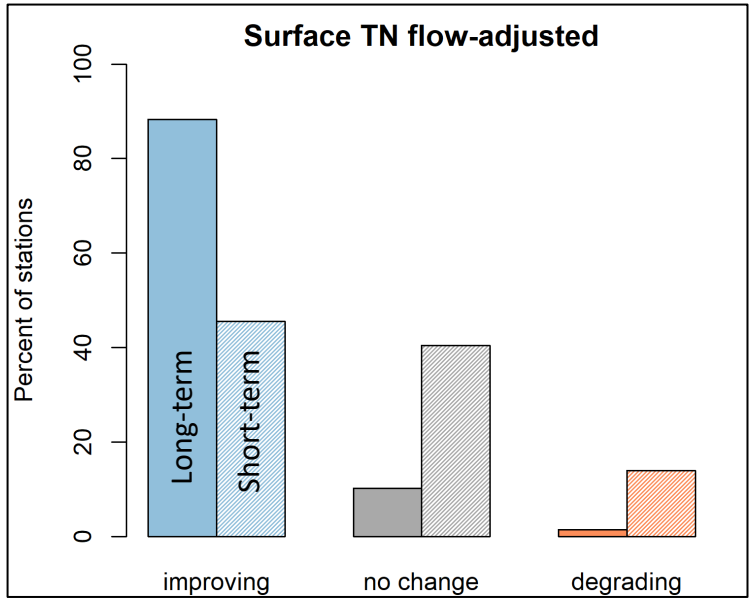
short-term

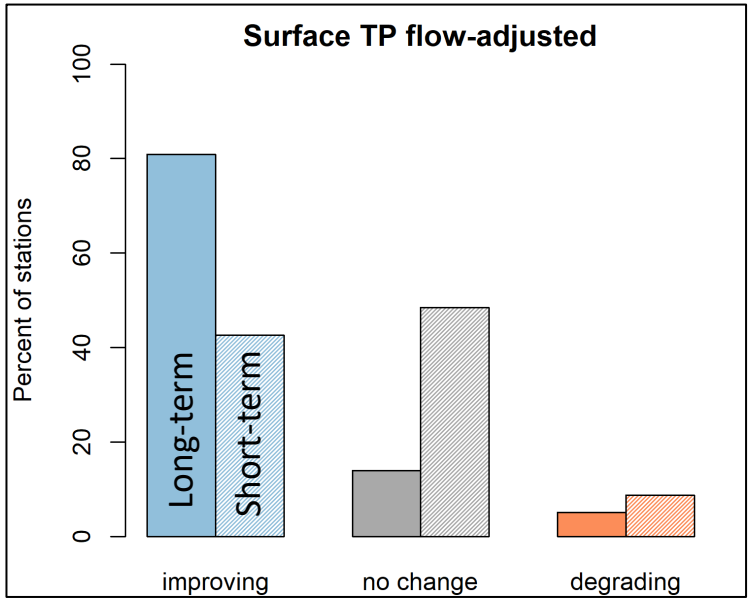




Total nutrients summary

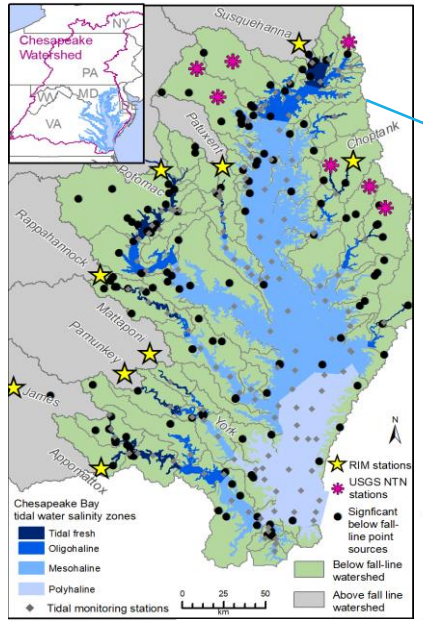
- Long-term decreases at most stations (bottom is similar).
- Short-term changes are mixed with some plateauing of previously decreasing loads.



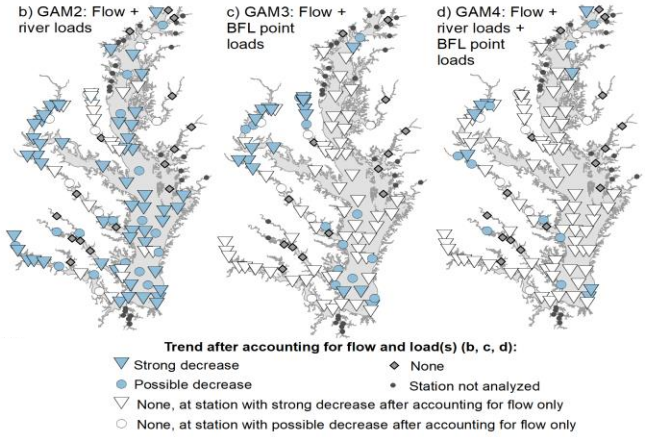


Using the results

Research explaining trends

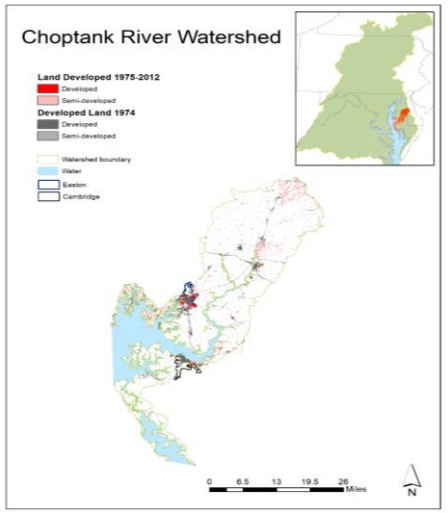


Point vs. riverine explanation of nutrient trends



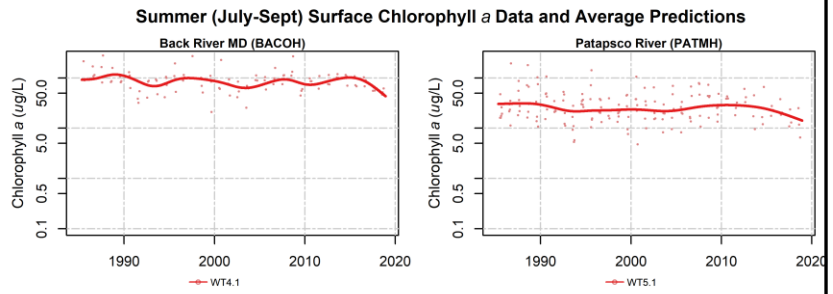
Murphy, Keisman, Perry, Harcum, Karrh, Lane, Zhang - in prep

Basin summaries



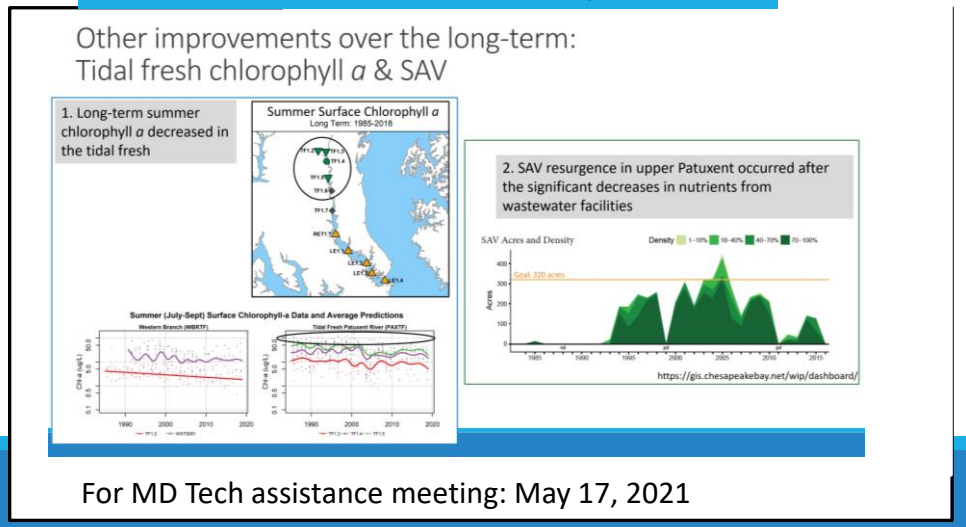
12 summaries documenting tidal trends & watershed factors by region

→ *available online very soon*



https://cast.chesapeakebay.net/Home/TMDLTracking#tributaryRptsSection

Technical assistance to partners



For MD Tech assistance meeting: May 17, 2021

Thank you

Tidal trends team:

- Jeni Keisman (USGS)
- Rebecca Murphy (UMCES/CBP)
- Elgin Perry
- Jon Harcum and Erik Leppo (Tetra Tech)
- Renee Karrh (MDDNR)
- Mike Lane (ODU)
- Cindy Johnson (VADEQ)

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