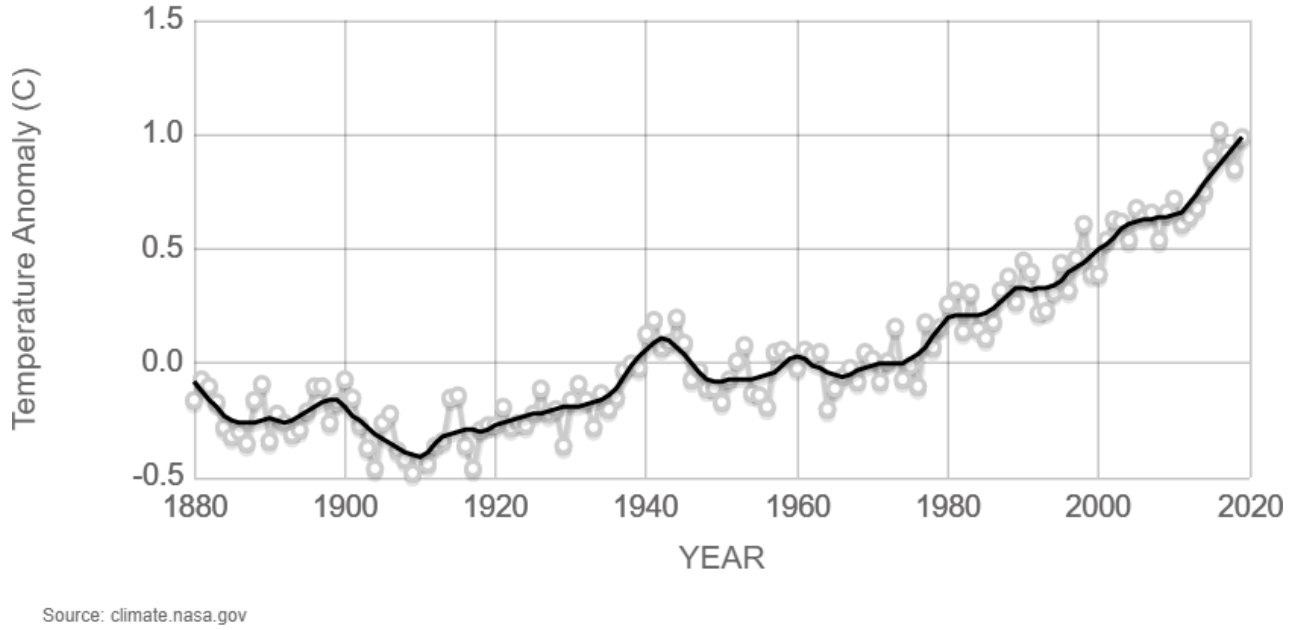
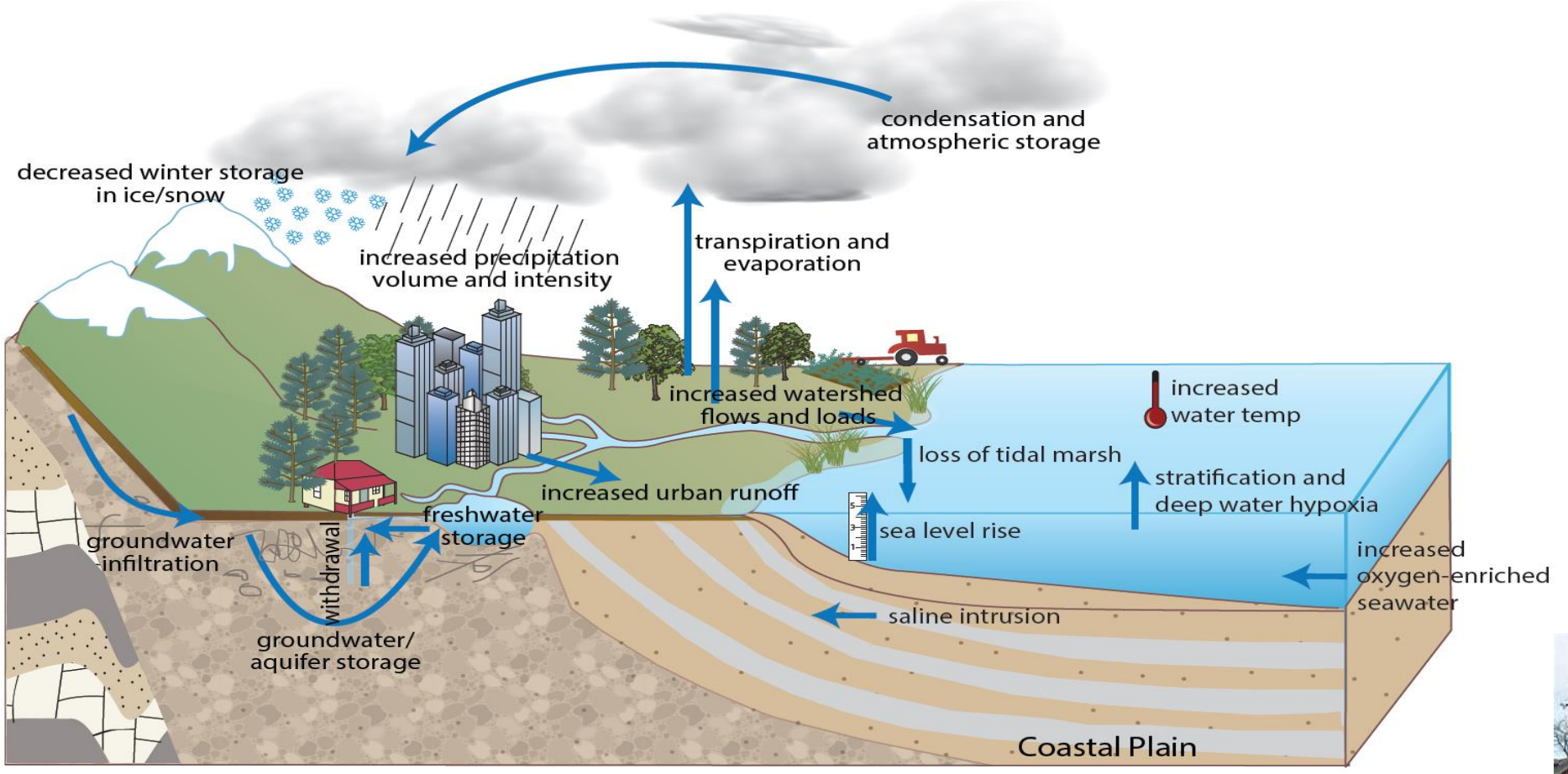
Question: Should Chesapeake Bay Water Quality Criteria be Adjusted for Shifting Temperature Baselines?

Peter Tango
USGS@CBPO
CAP WG discussion
11/18/2020

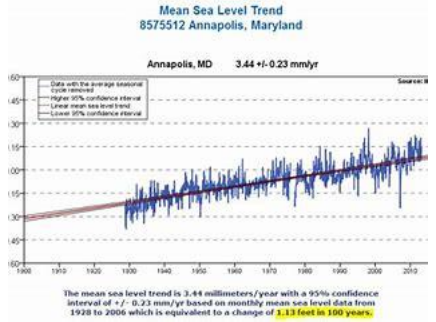


Global temperature trend 1880-2020

Climate Influence on the Chesapeake Bay Watershed



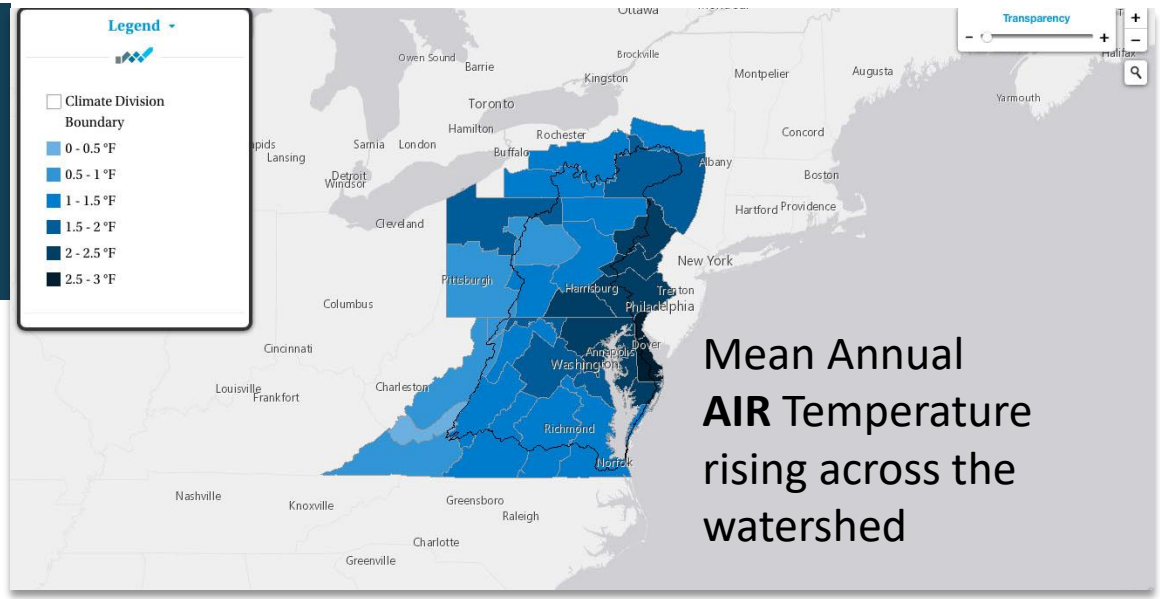
Source: CBP Modified UMCES/ IAN graphic (2011)

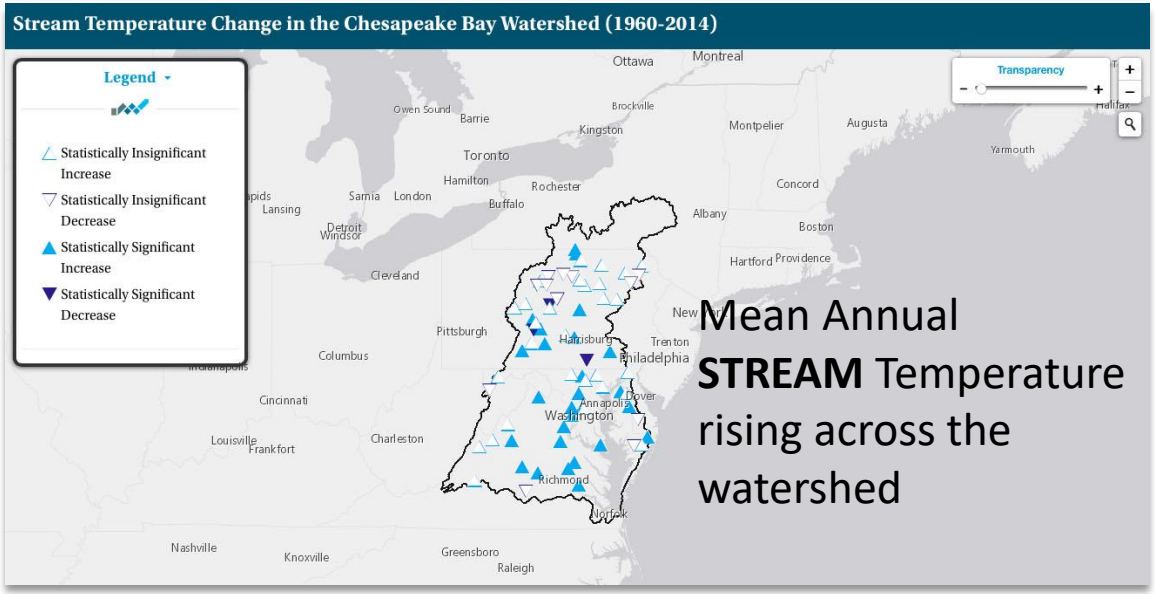


USGS science for a changing world

Shifting baselines: Temperature

- Air temperature rising, locally variability in rate
- Stream temperature rising, some local variation



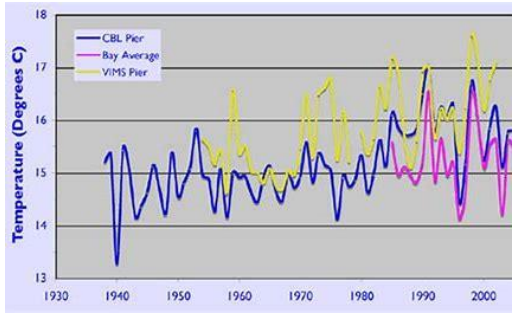


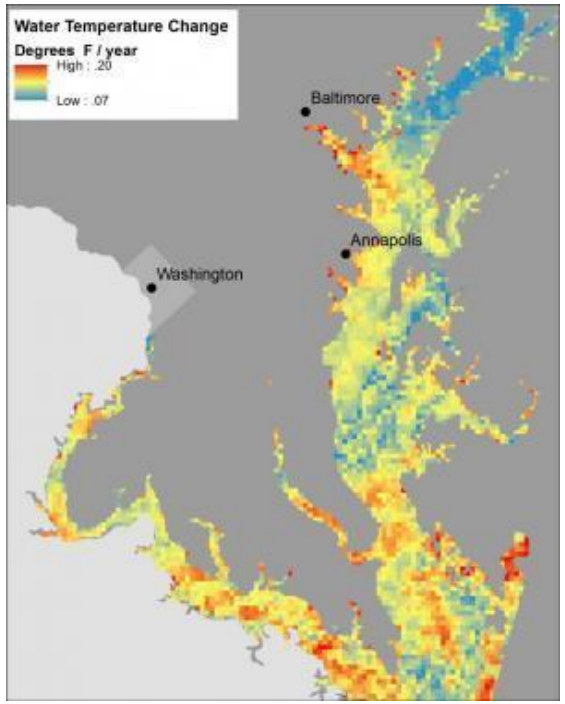
https://www.chesapeakeprogress.com/climate-change/climate-monitoring-and-assessment

Shifting baselines: Temperature

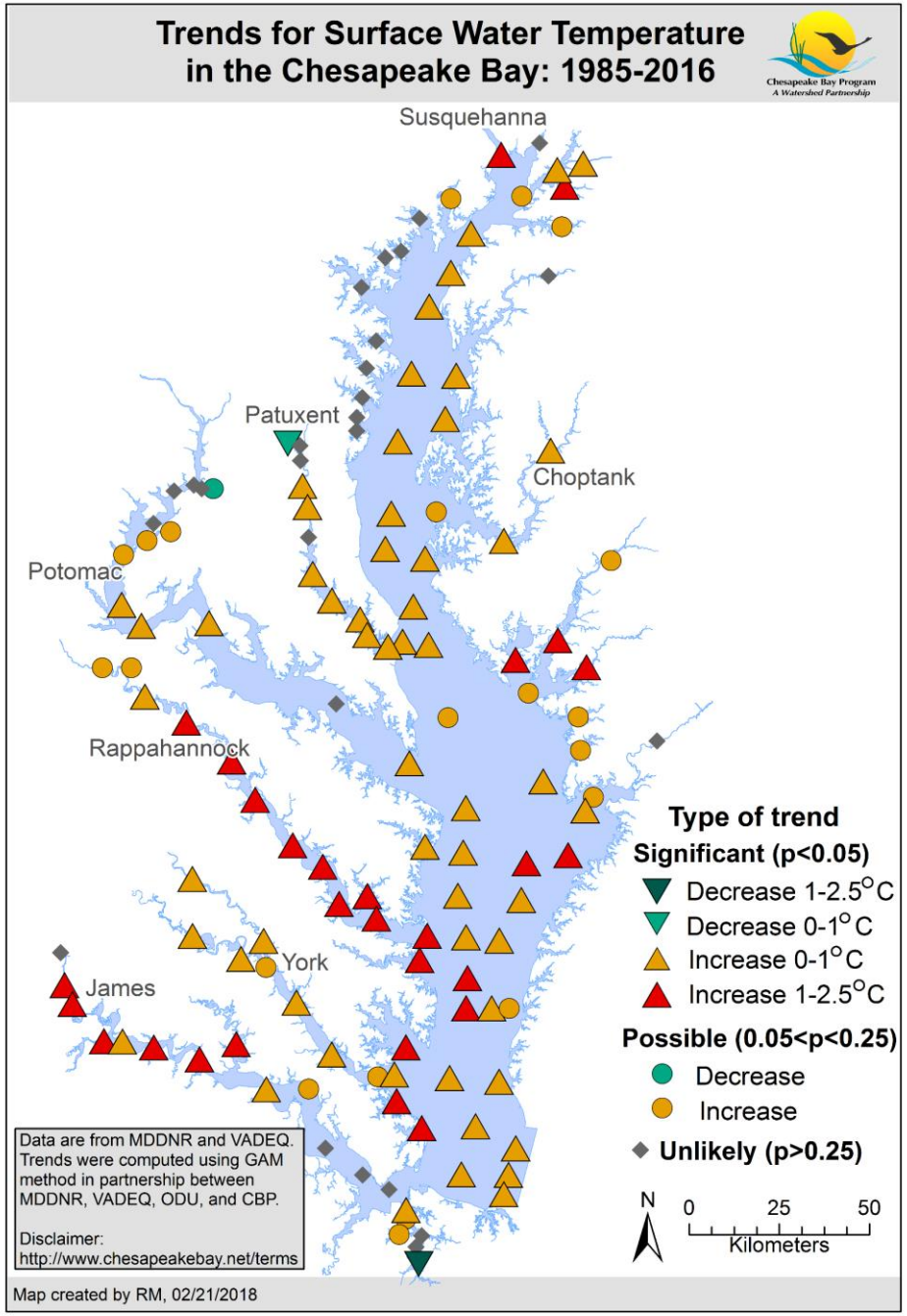
- Bay temperatures rising

Local scale: CBL and VIMS pier





Ding and Elmore. UMCES.
Remote Sensing in the Environment

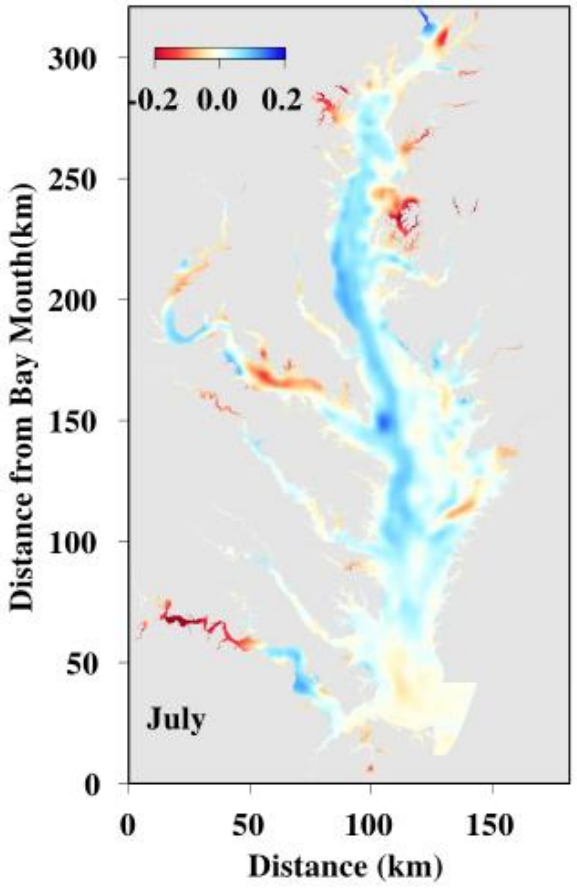


Chesapeake Bay Program
Science, Restoration, Partnership

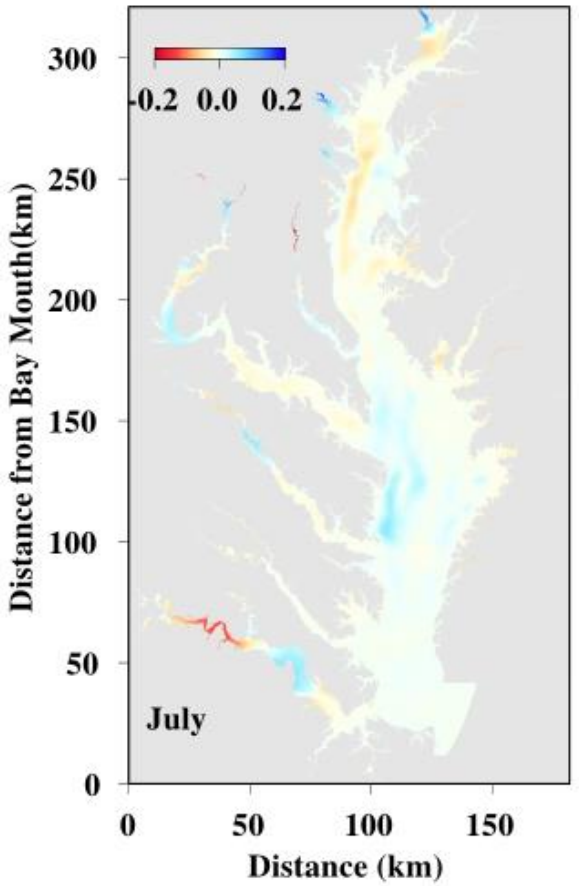
Climate and Bottom Dissolved Oxygen Change: 1995 to 2025

New insights: Keeping all other factors constant, sea level rise and increased watershed flow reduce hypoxia in the Bay, but ***the predominant influence on dissolved oxygen conditions are the negative impacts of increased water column temperatures***.

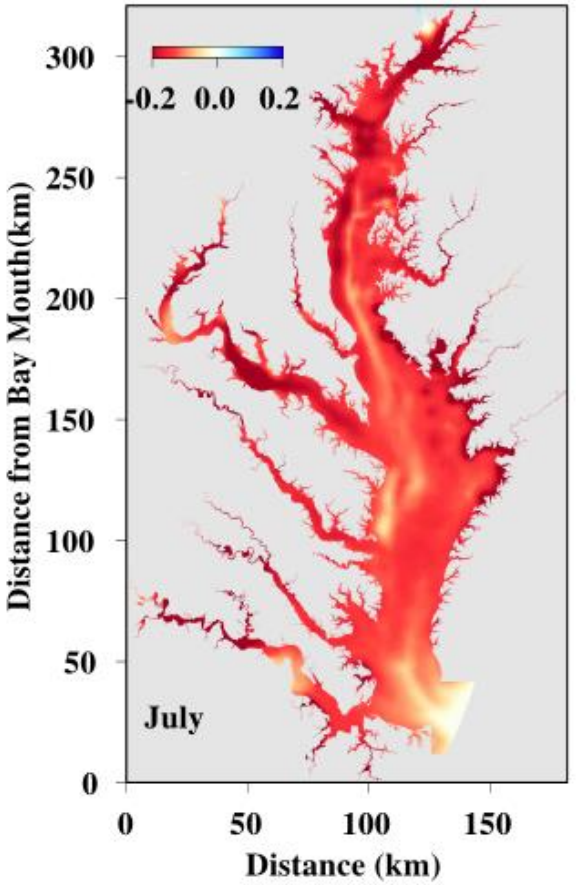
Sea Level Rise



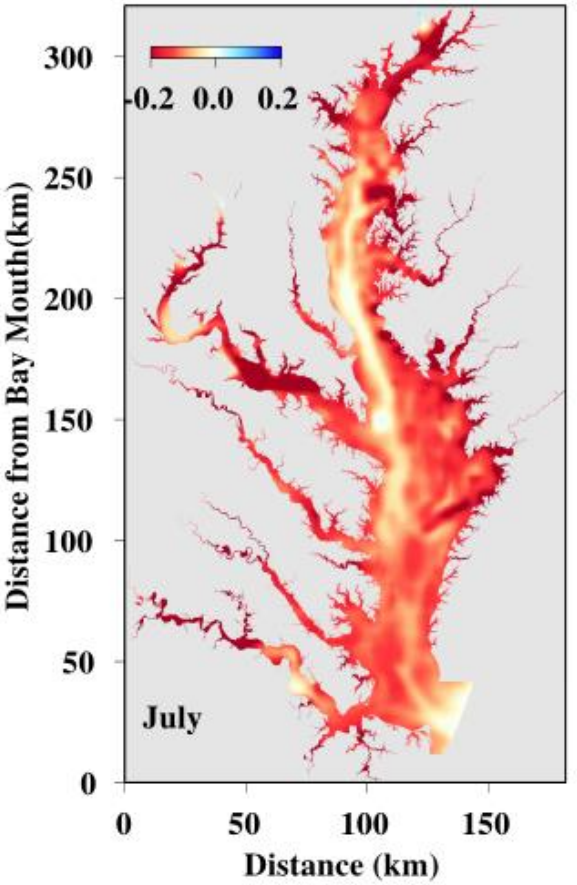
Watershed Flow



Increased Temp.



All Factors

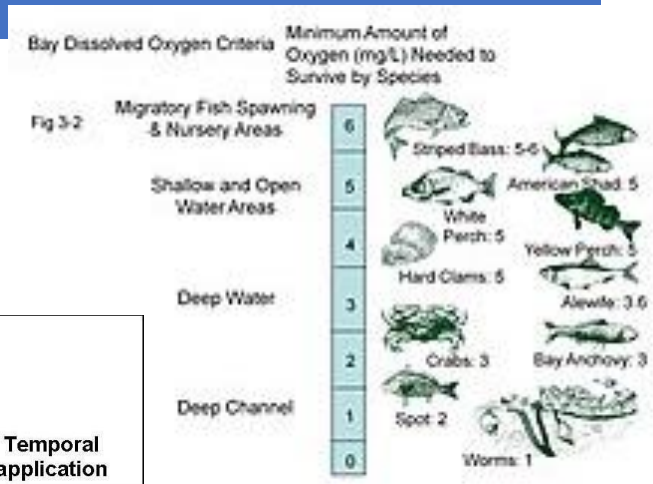


Source: Lew Linker EPA-CBPO

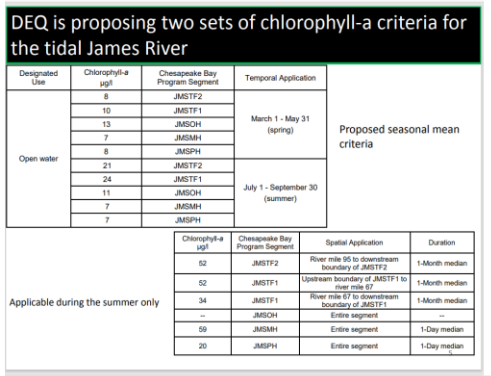
Question: Should Chesapeake Bay Water Quality Criteria be adjusted for shifting temperature baselines?

Reminder on Criteria

- Dissolved oxygen
- SAV/Water Clarity
- CHLA

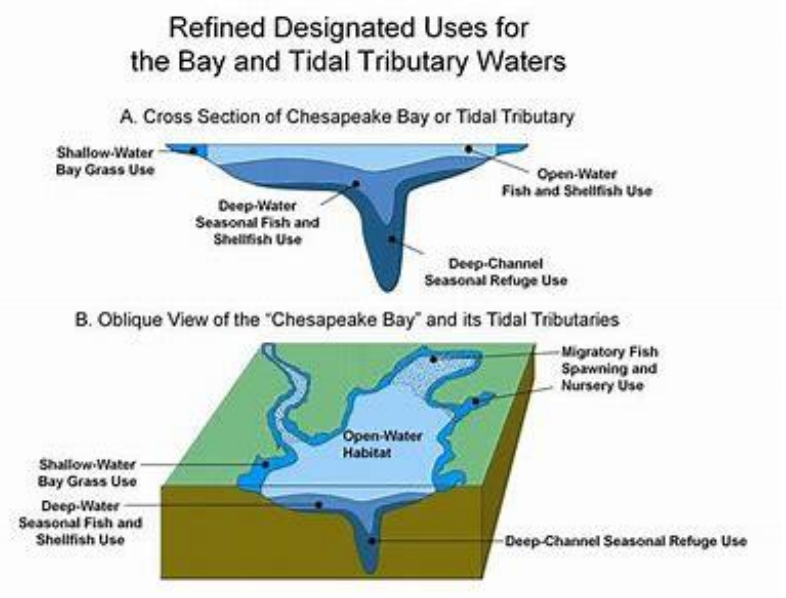


Salinity regime[b]	Water clarity criteria (percent light-through-water)	Water clarity criteria as Secchi depth[a]								Temporal application
		Water clarity criteria application depths (meters)								
		0.25	0.5	0.75	1.0	1.25	1.5	1.75	2.0	
		Secchi depth for above criteria application depth (meters)								
Tidal-fresh	13%	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	April 1–Oct 31
Oligohaline	13%	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	April 1–Oct 31
Mesohaline	22%	0.2	0.5	0.7	1.0	1.2	1.4	1.7	1.9	April 1–Oct 31
Polyhaline	22%	0.2	0.5	0.7	1.0	1.2	1.4	1.7	1.9	March 1–May 31 Sept 1–Nov 30



Reminder on Criteria

- Dissolved oxygen criteria
  - Temperature is built into defining designated uses (salinity and temperature for pycnocline definitions)
  - Temperature is built into seasonal designated use applications
  - Short-nosed sturgeon provide for temperature adjusted criteria protections already***
  - Our criteria setting process relies on species DO needs. Unless a sensitive species goes extinct, there is no living resource basis for changing DO criteria yet.



*** - "***At temperatures considered stressful to shortnose sturgeon (> 29°C), dissolved oxygen concentrations above an instantaneous minimum of 4.3 mg liter^{-1} will protect survival of this listed sturgeon species***."

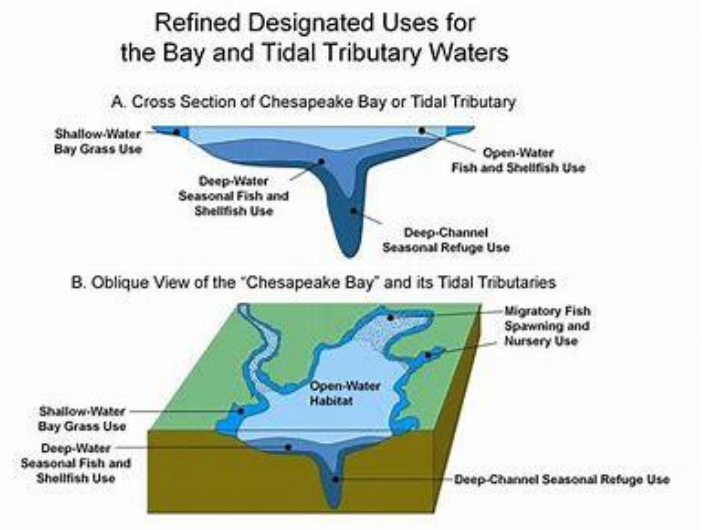
USEPA (2003)

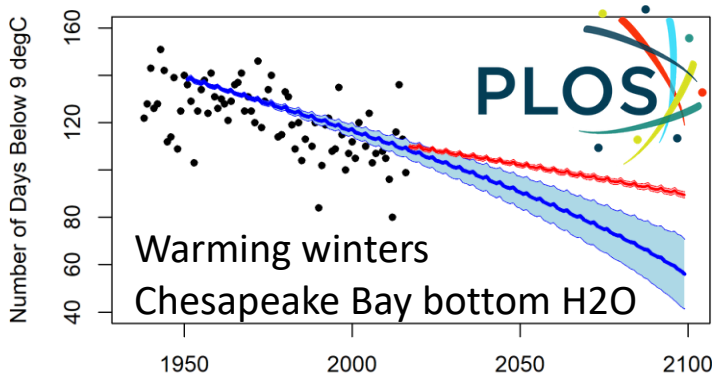
Striped bass are distributed from Louisiana to the Gulf of St. Lawrence.

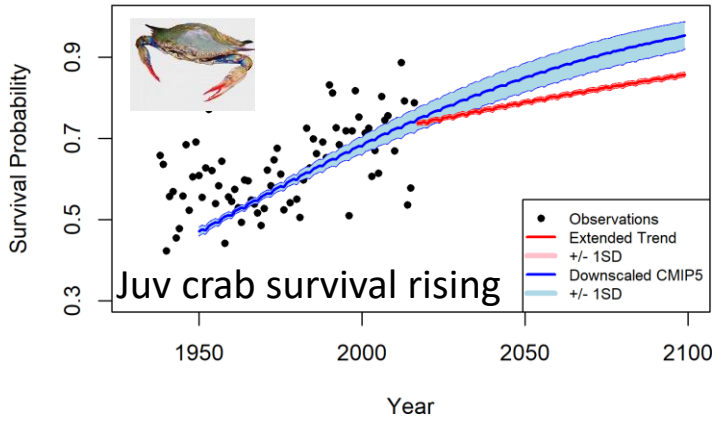
They aren’t going away anytime soon in the face of rising bay temperatures.

Reminder on Criteria

- Dissolved oxygen criteria
  - Temperature is built into defining designated uses (salinity and temperature for pycnocline definitions)
  - Temperature is built into seasonal designated use applications
  - Short-nosed sturgeon provide for temperature adjusted criteria protections already
  - Our criteria setting process relies on species DO needs. Unless a sensitive species goes extinct, there is no living resource basis for changing DO criteria yet.
    - However, consider designated use definitions that reflect seasons where criteria apply. Up for discussion here?







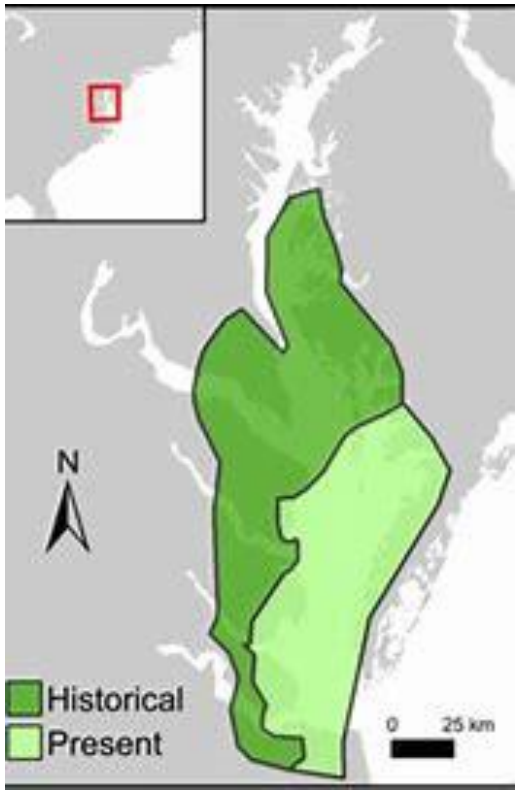
Winter is (not) coming: Warming temperatures will affect the overwinter behavior and survival of blue crab

•Hillary Lane Glandon , K. Halimeda Kilbourne , Thomas J. Miller

•Published: July 25, 2019 https://doi.org/10.1371/journal.pone.0219555

Reminder on Criteria

- SAV/Water Clarity
  - SAV light requirements have a temperature relationship (R. Batiuk, Pers. Comm.)
  - We could lose a key species in the bay as a function of temperature effects.
    - Are other species backfilling the area eelgrass occupied?
    - Will new species have different light requirements that would impact goal setting and outcome expectation for restoration under new climate conditions?



Eelgrass distribution is shrinking.
Source: VIMS

Reminder on Criteria

- CHLA considerations

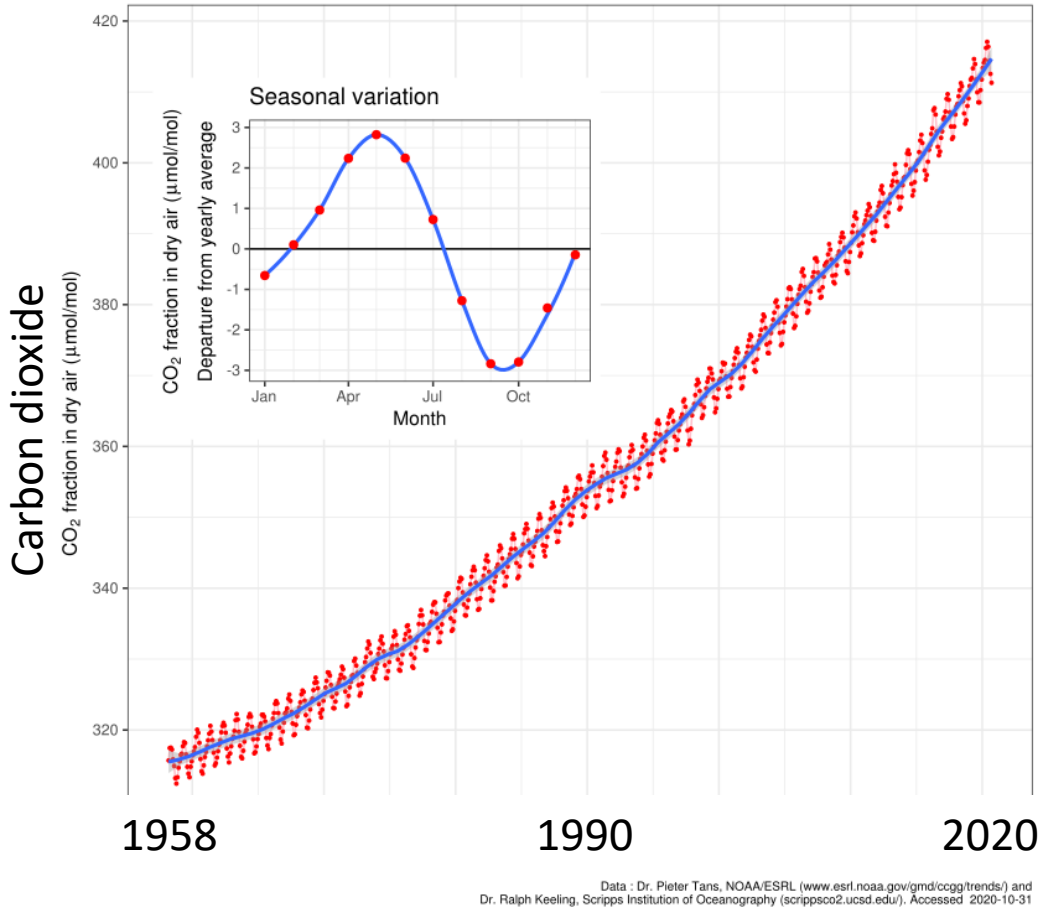
We have seasonal applications now, however,

- Toxic blue-green algae prefer warmer water.
- Warmer temperatures prevent water from mixing, allowing algae to grow thicker and faster.
- Warmer water is easier for small organisms to move through and allows algae to float to the surface faster.
- Algal blooms absorb sunlight, making water even warmer and promoting more blooms.

CHLA criteria – Adjust for rising CO2 too?

- **Higher carbon dioxide levels**
  - Algae need carbon dioxide to survive. Higher levels of carbon dioxide in the air and water can lead to rapid growth of algae, especially toxic blue-green algae that can float to the surface of the water.

Monthly Mean
Carbon Dioxide Concentration
1958-2020
Mauna Loa (Keeling) Curve



Question: Should Chesapeake Bay Water Quality Criteria be adjusted for shifting temperature (and other important) baselines?