Application of continuous monitoring oxygen data: the Chesapeake Bay Environmental Forecasting System (CBEFS)

Marjorie Friedrichs, Pierre St-Laurent

Virginia Institute of Marine Science

Aaron Bever

Anchor QEA

www.vims.edu/cbefs

Chesapeake Bay Program

Science. Restoration. Partnership.

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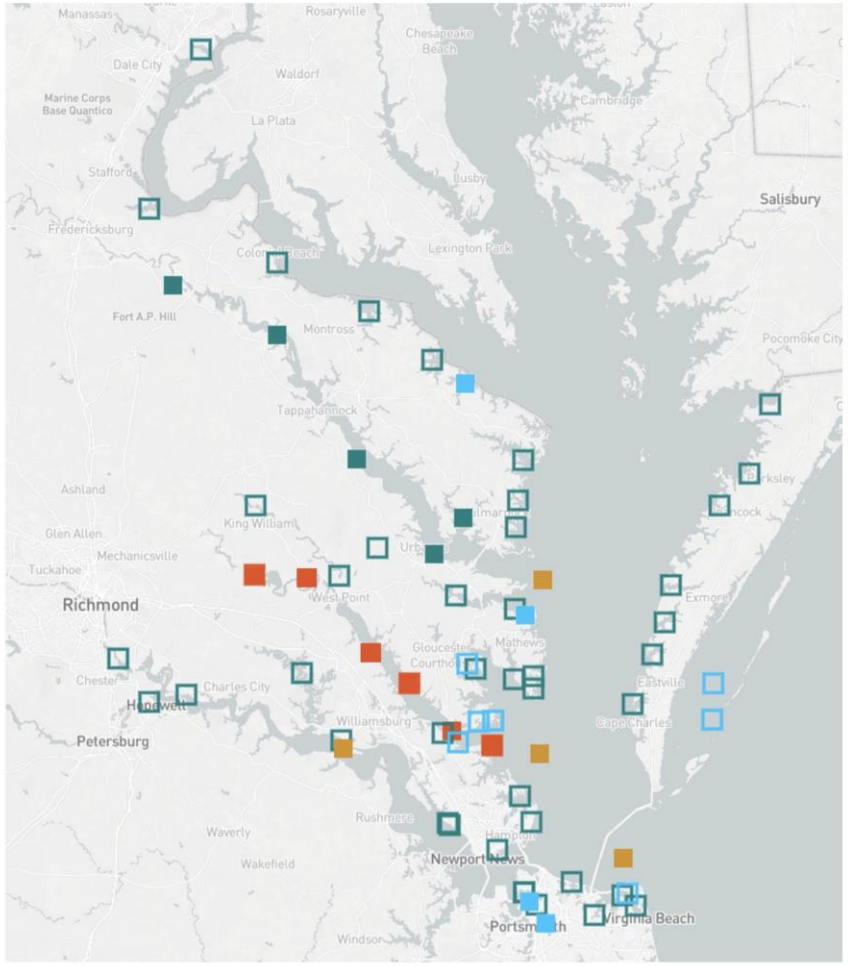
Virginia Continuous Monitoring Stations

Lots more in Maryland!



Active in 2023

Past stations

CBNERR-VA Project Category:

NOAA NERRS

Virginia DEQ

NOAA CBIBS

VIMS Water Quality Initiatives

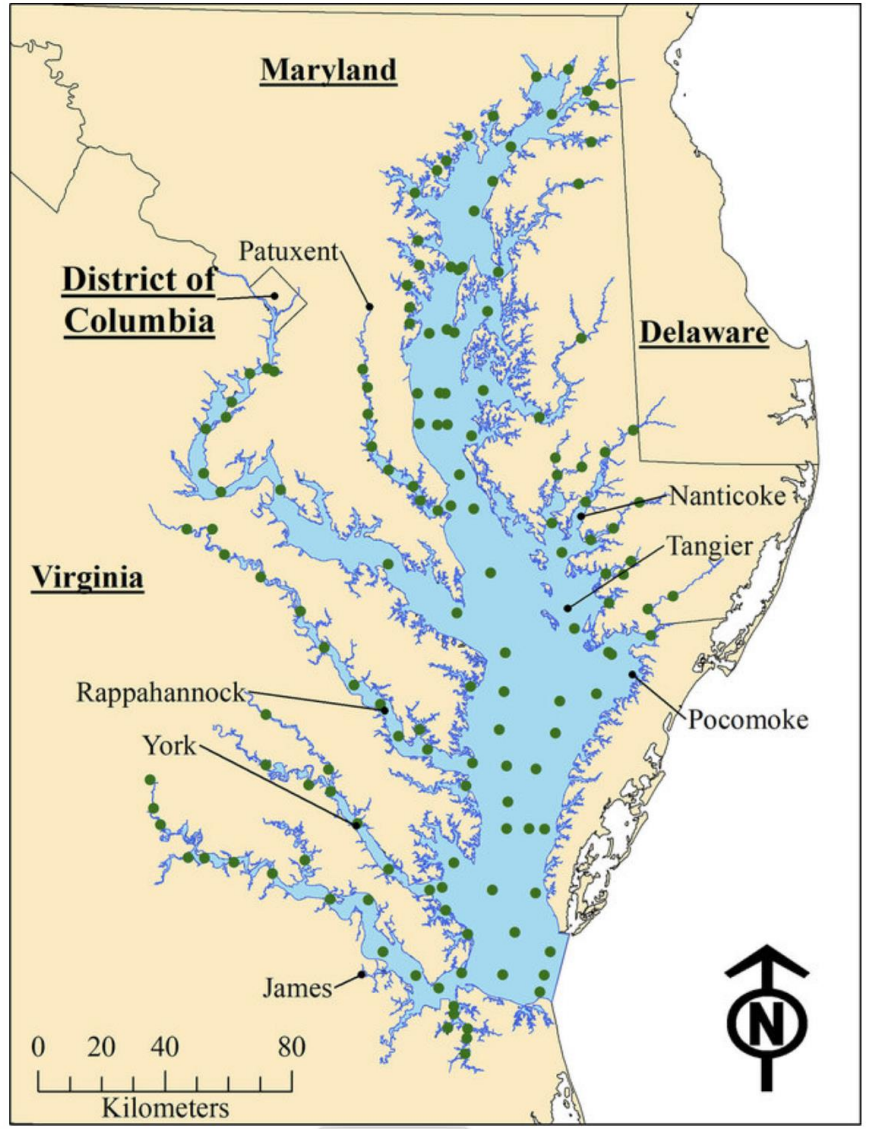
Data available at vecos.vims.edu

Source: CBNERR-VA 2023

Data are critical for Chesapeake Bay modeling!

From last talk, *in situ* data are critical for:

- Model development
- Model improvement
- Model evaluation
- Increasing confidence of end-users

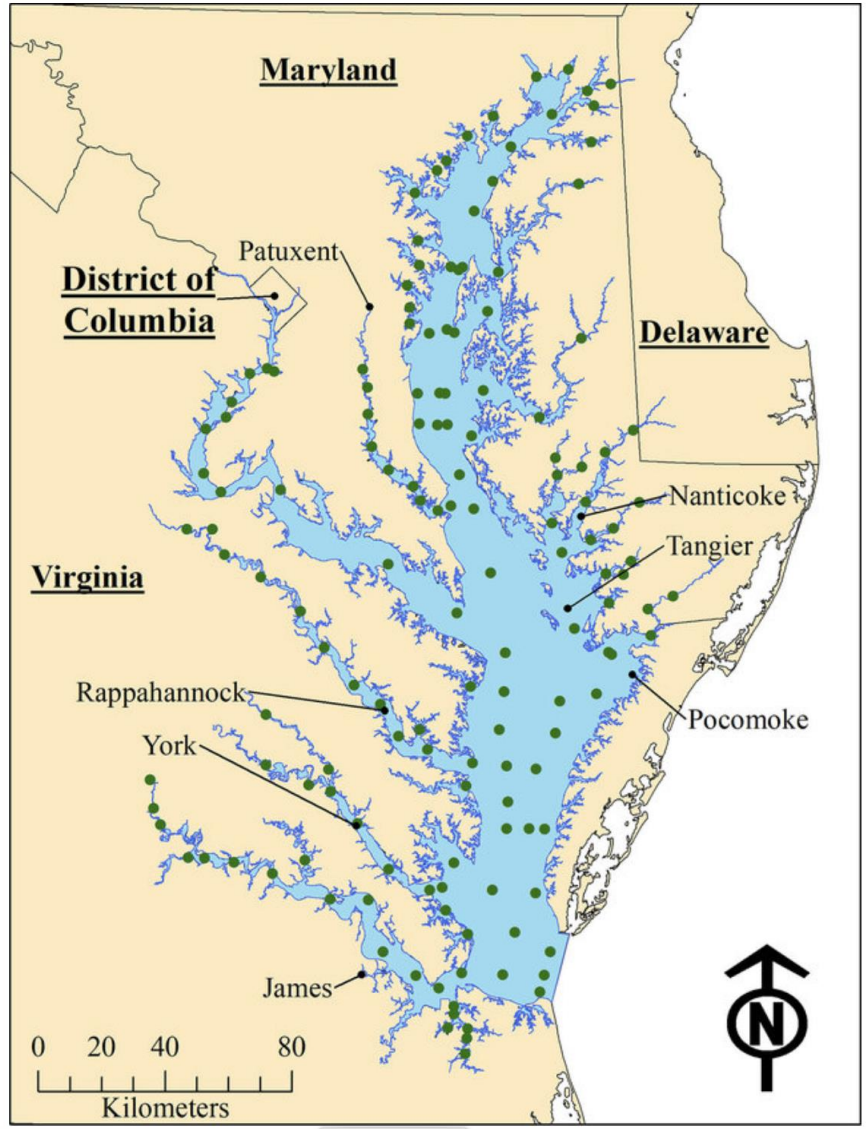


From: Davis et al., 2019

Data are critical for Chesapeake Bay modeling!

Forecast model is evaluated with:

- CBP WQMP station data
- Continuous monitoring station data
- And now, vertical profile station data!



From: Davis et al., 2019

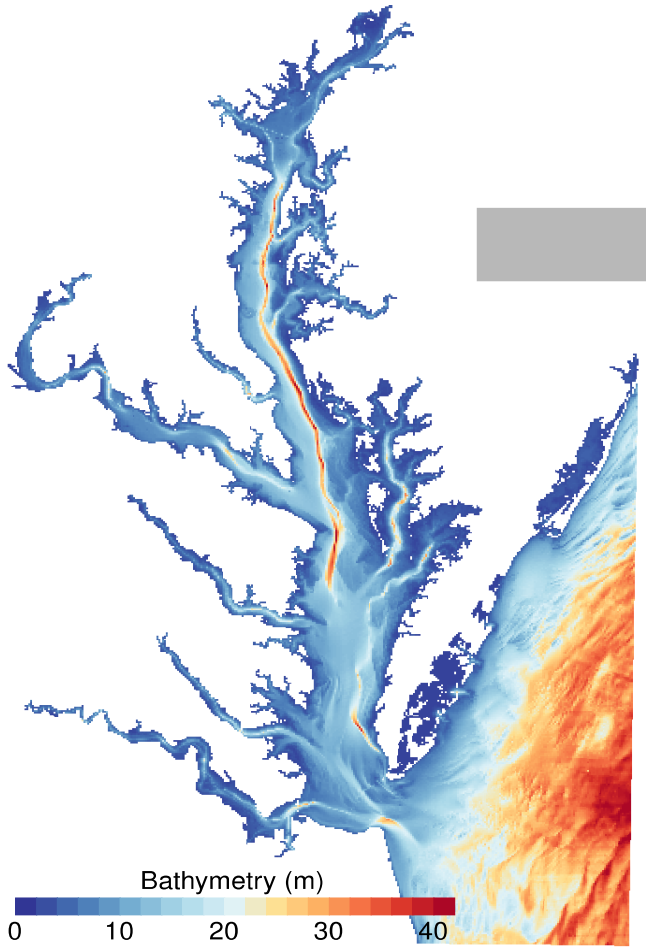
CBEFS: Chesapeake Bay Environmental Forecast System

Atmospheric inputs

Terrestrial inputs

Coastal inputs

Evaluate model performance with observational water quality data

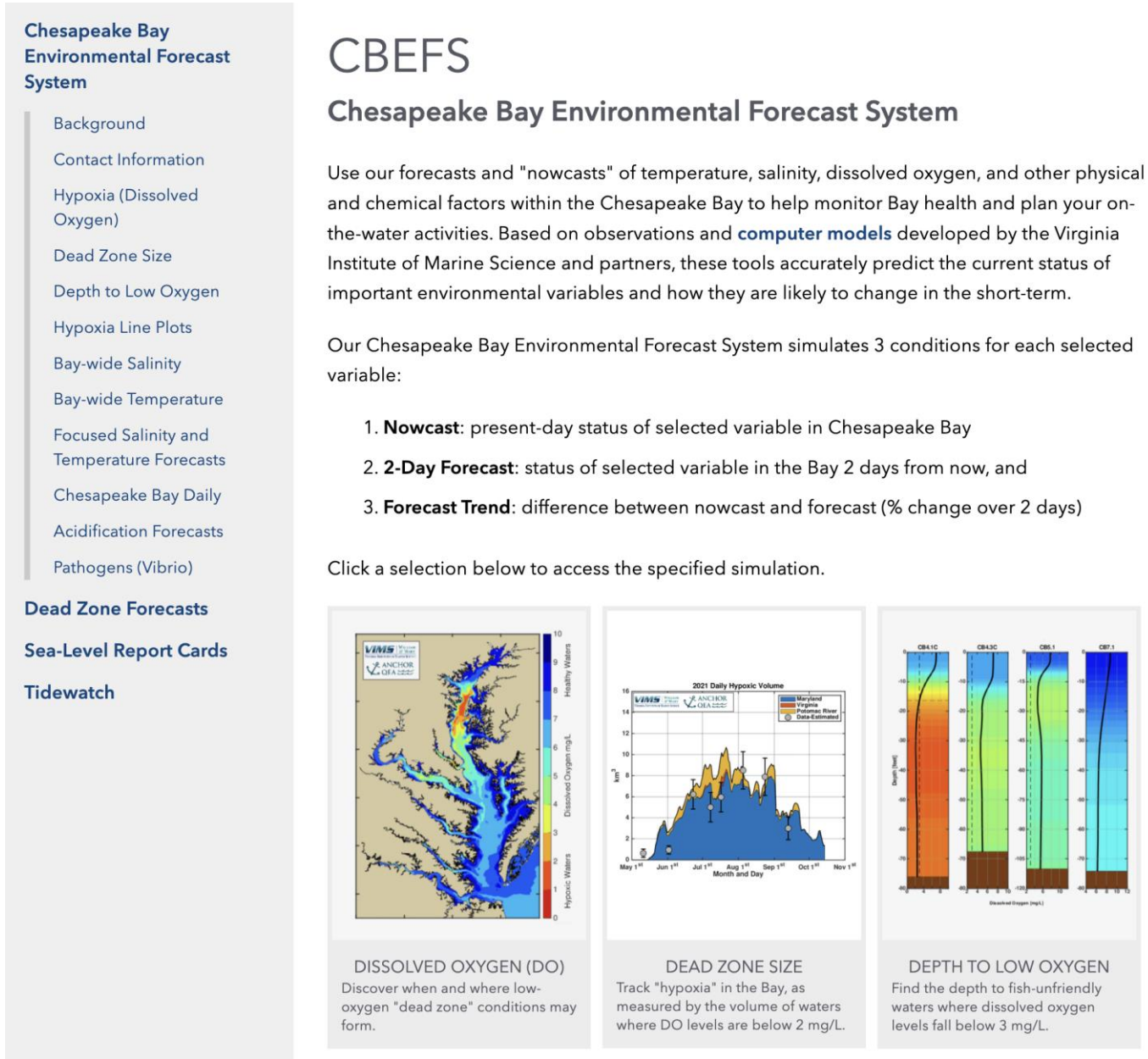


Real-time model forecast setup:

- Nowcast and 2-day forecast automatically produced nightly
- Forecasts displayed on the VIMS website

www.vims.edu/cbefs

CBEFS: Chesapeake Bay Environmental Forecast System



- Temperature
- Salinity
- Hypoxia/Dead Zone size
- Acidification metrics
- Bacteria (Vibrio)
- Harmful Algal Blooms (HABs)
- Water Clarity
- Waves

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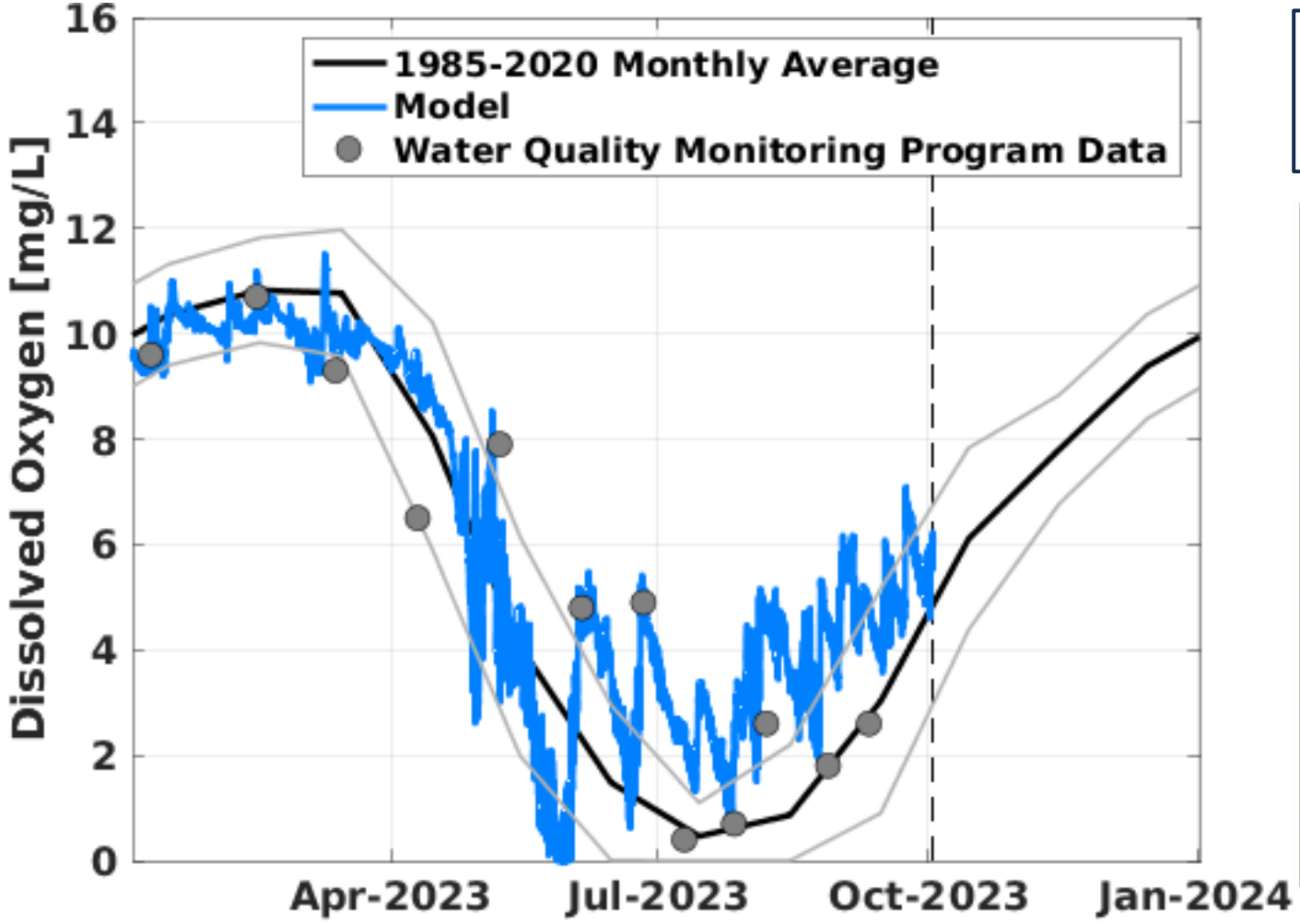
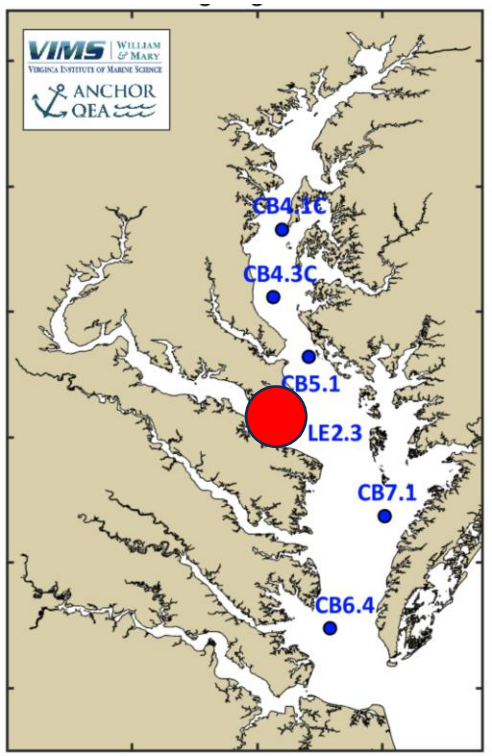
CBEFS comparison with CBP WQ Monitoring Program Station data

= 15min model output

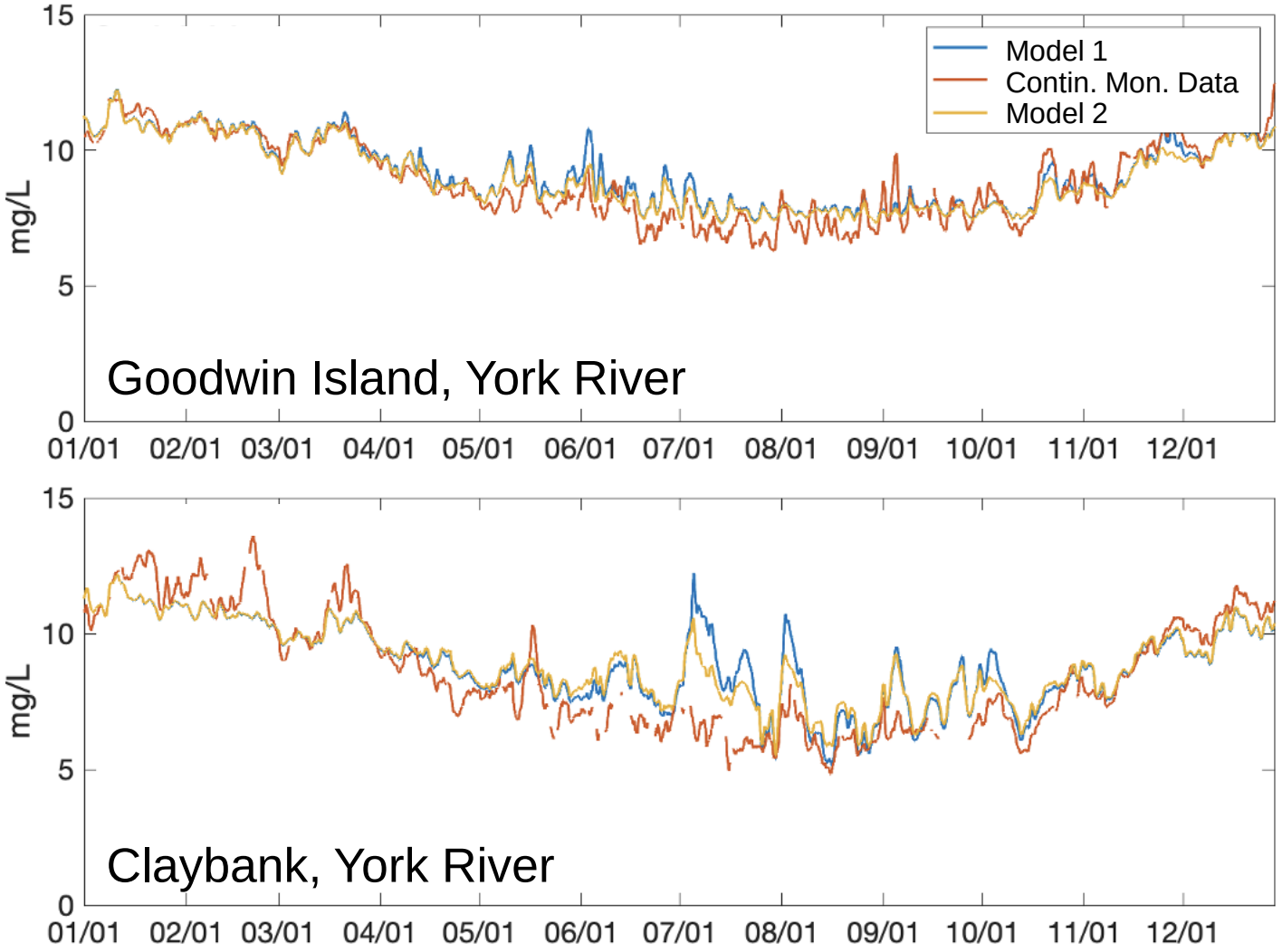


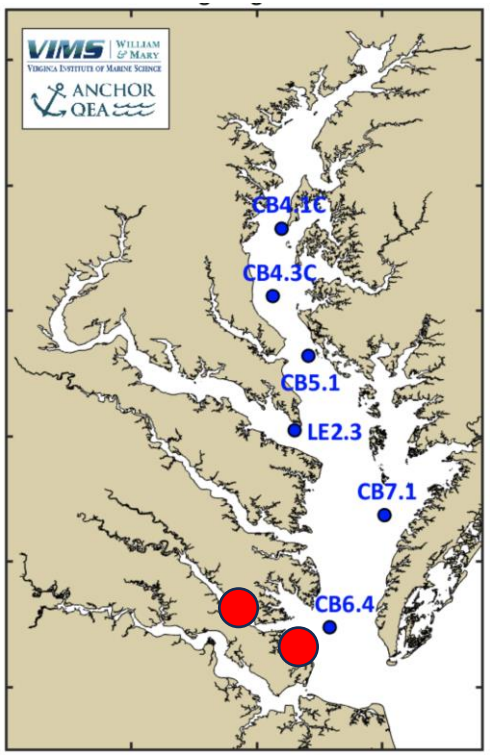
LE2.3 in lower Potomac



CBEFS comparison with Continuous Monitoring Station data

Dissolved Oxygen

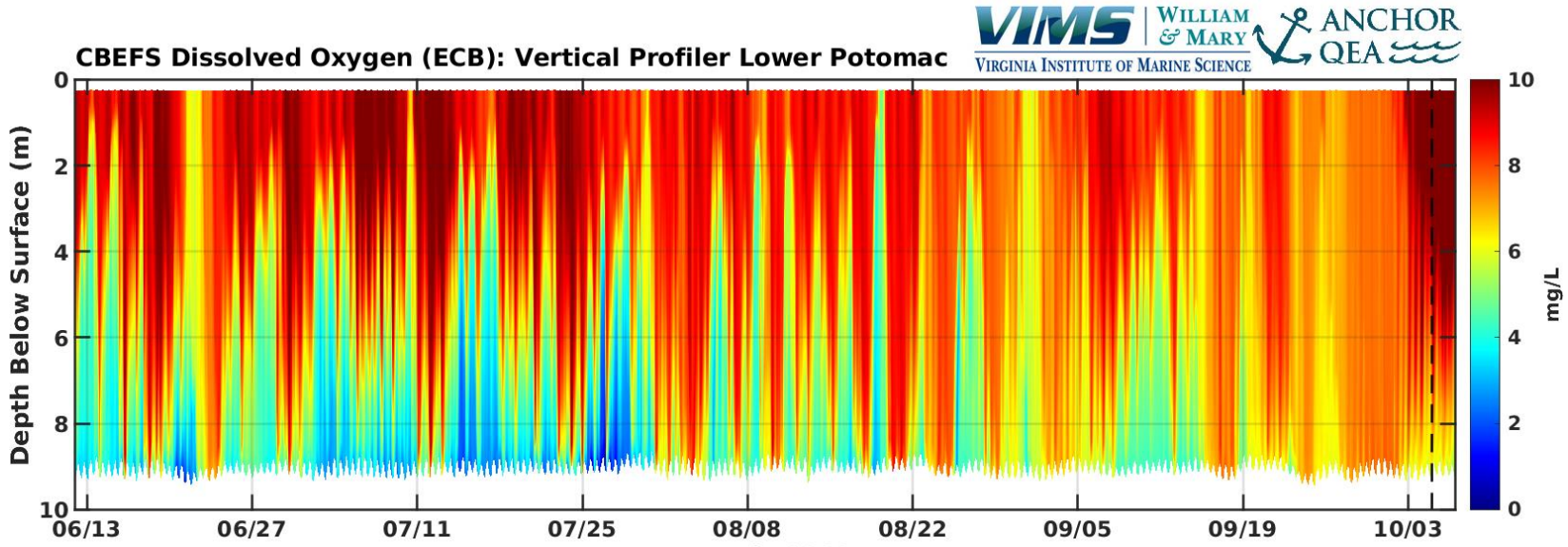




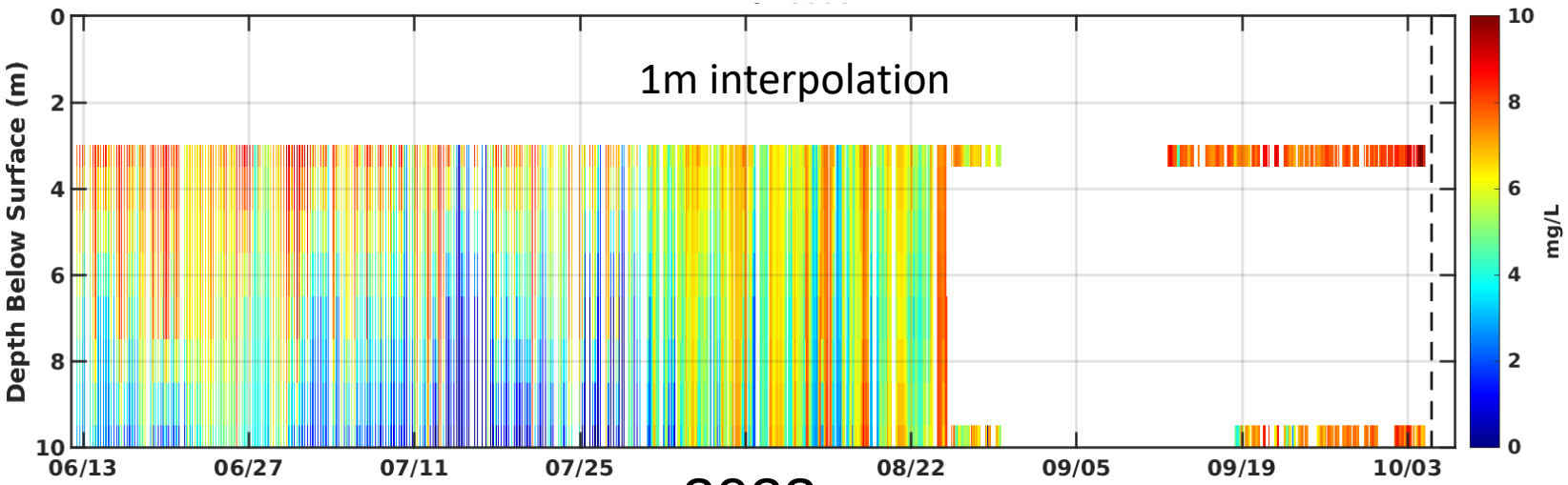
CBEFS comparison with Vertical Profile Station data

Note
Red is High O_2!
Blue is hypoxia!

CBEFS Oxygen

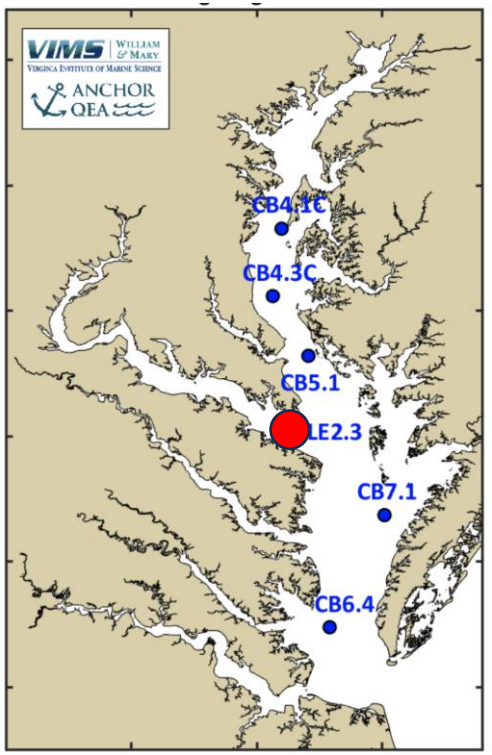


Vertical Profile Oxygen Data



2023

Lower Potomac



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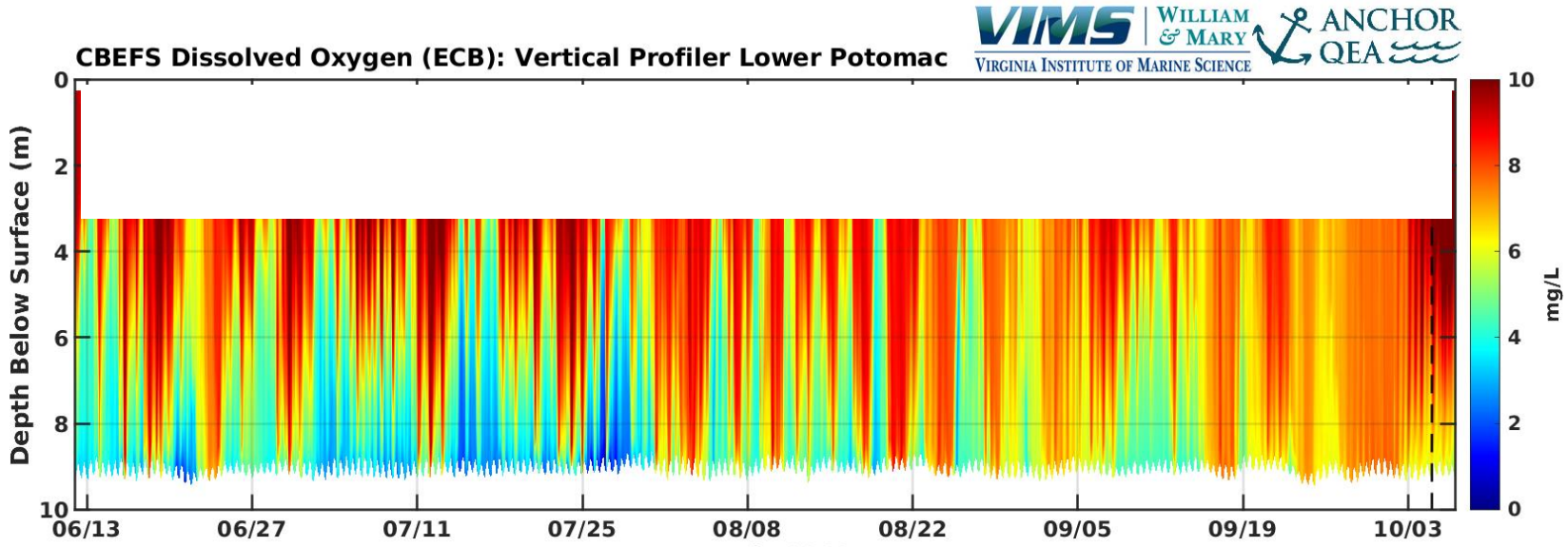
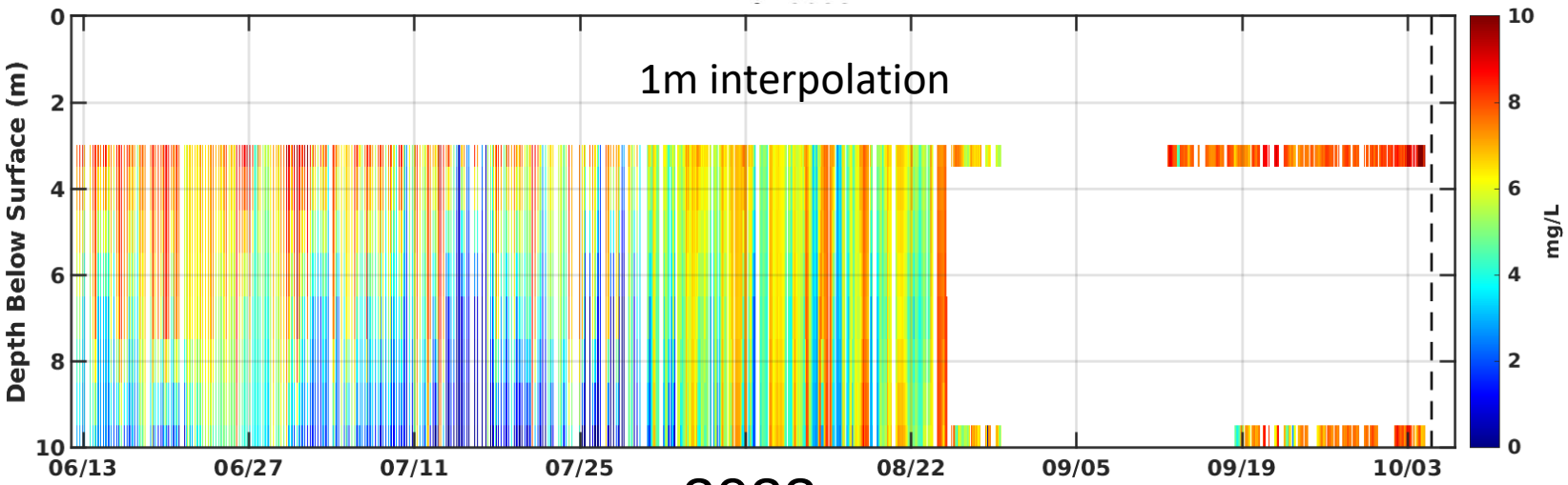


Vertical Profile Oxygen Data



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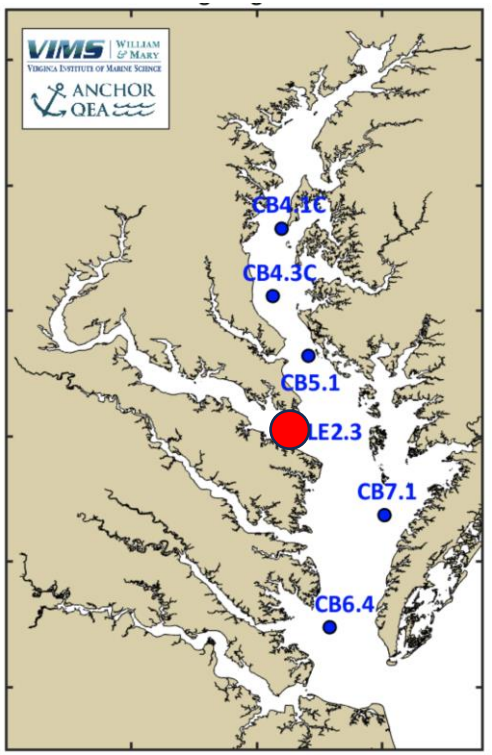

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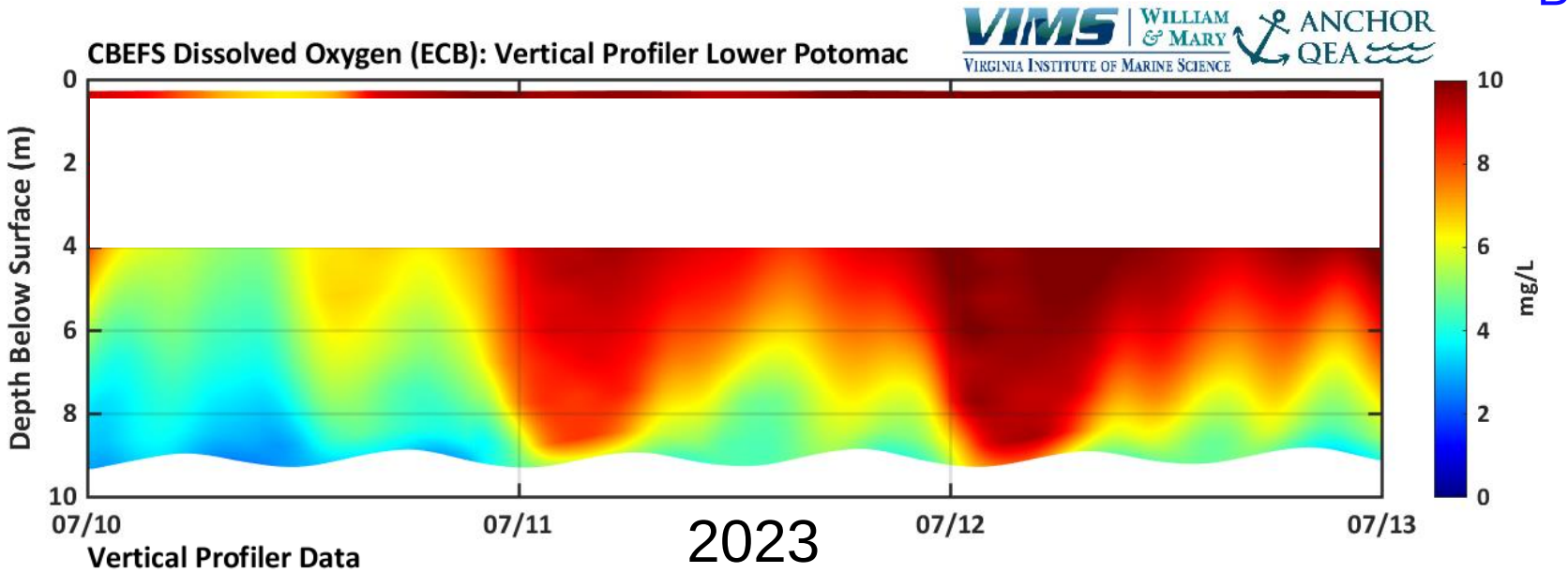
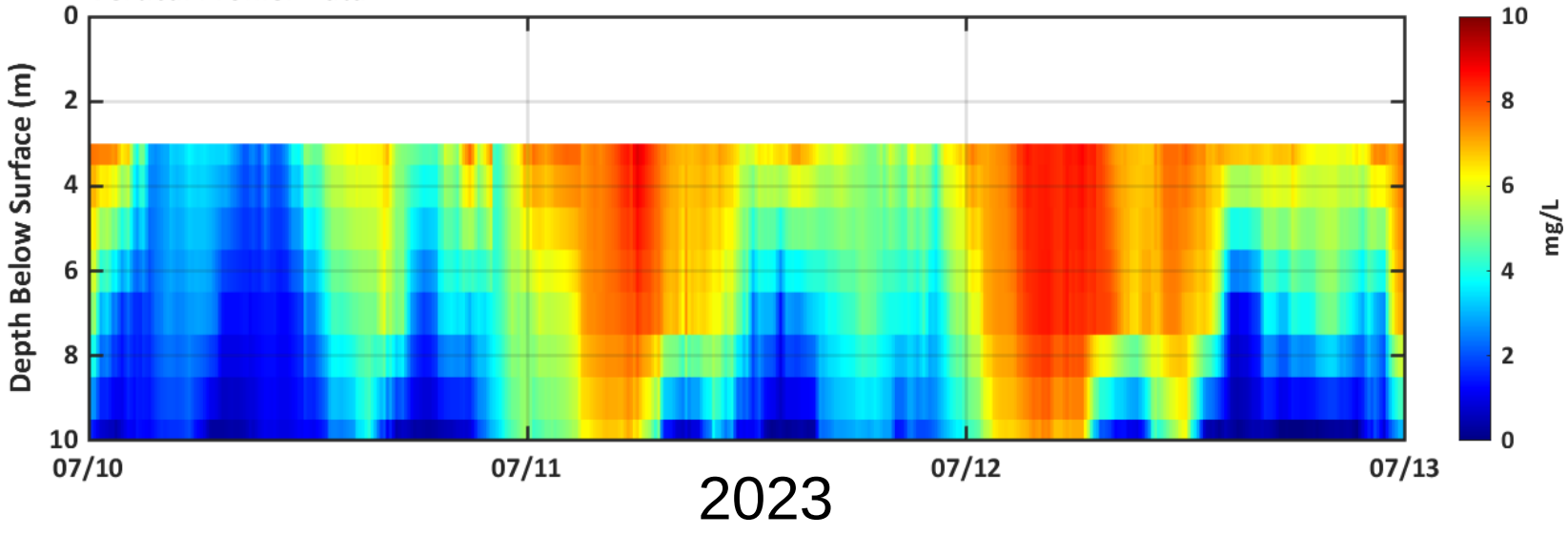
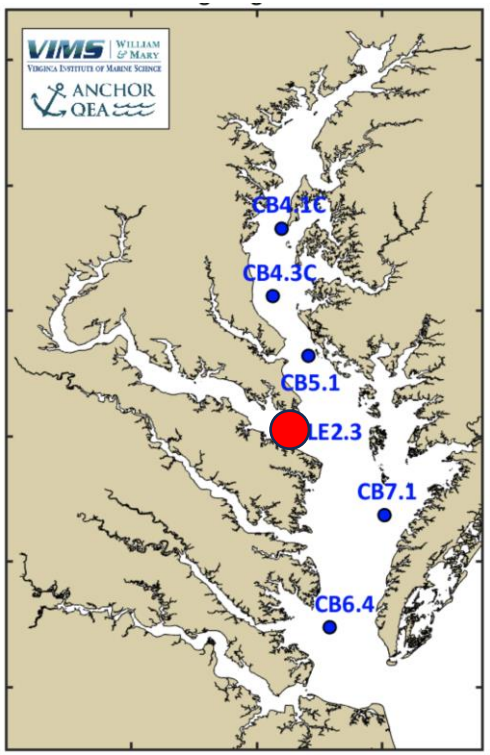


Vertical Profile Oxygen Data



Lower Potomac



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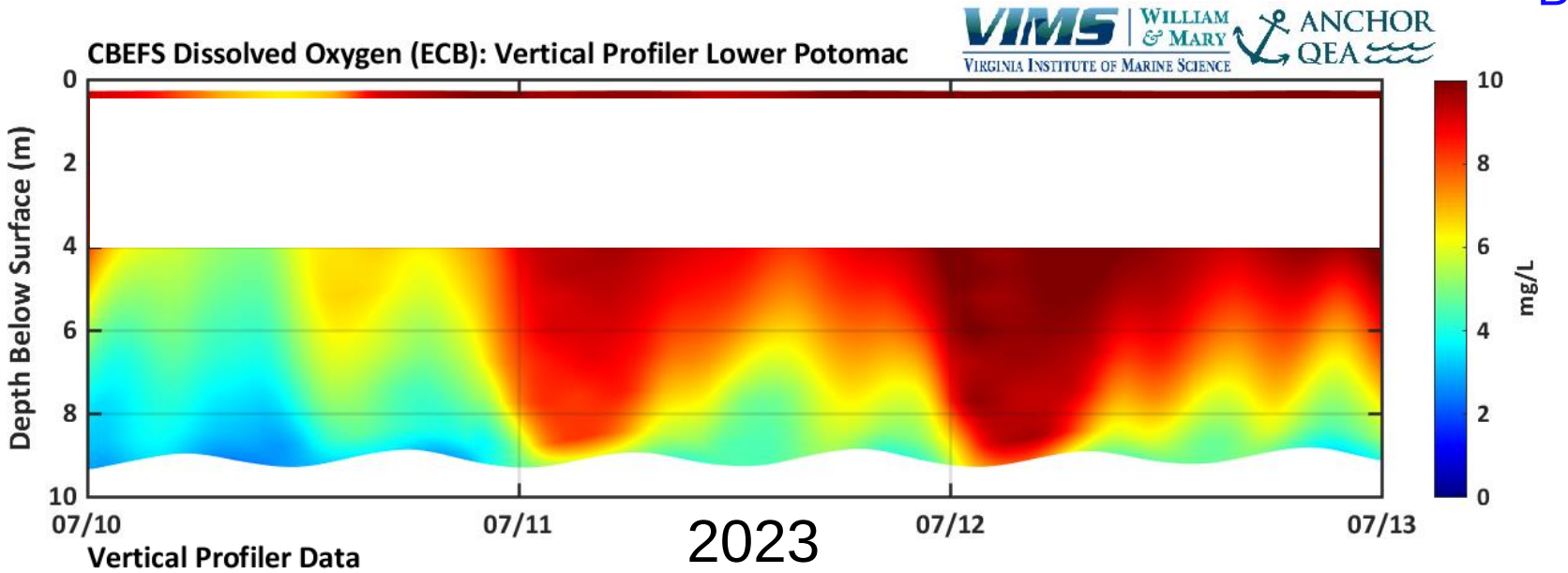
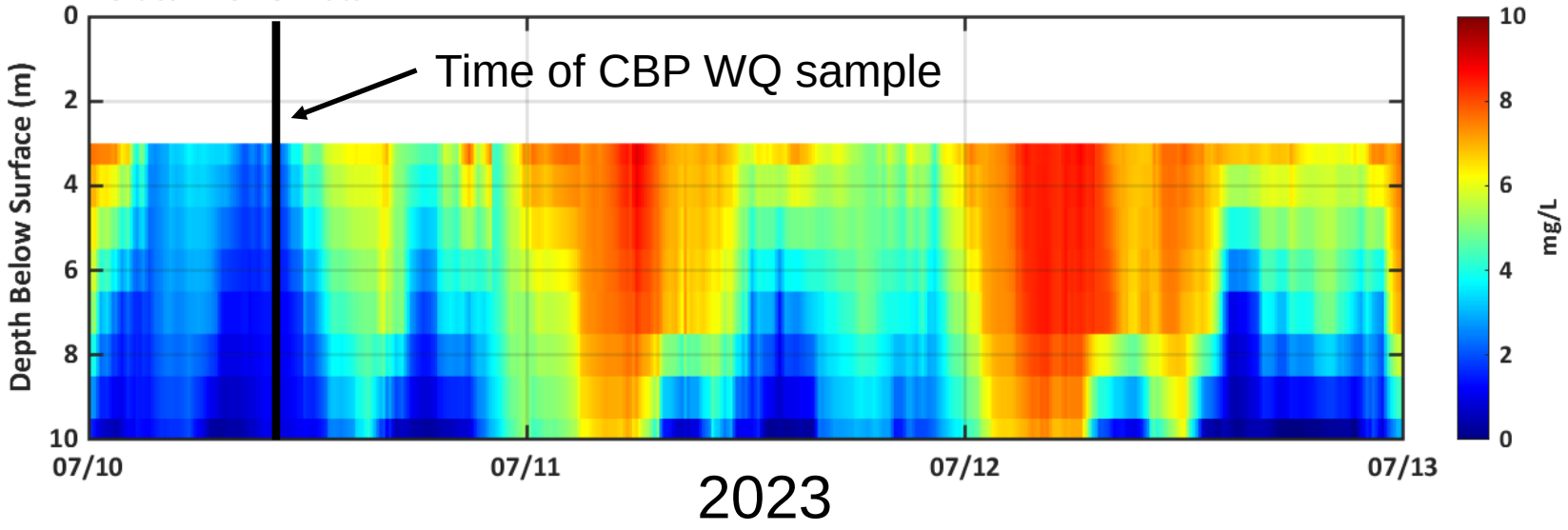
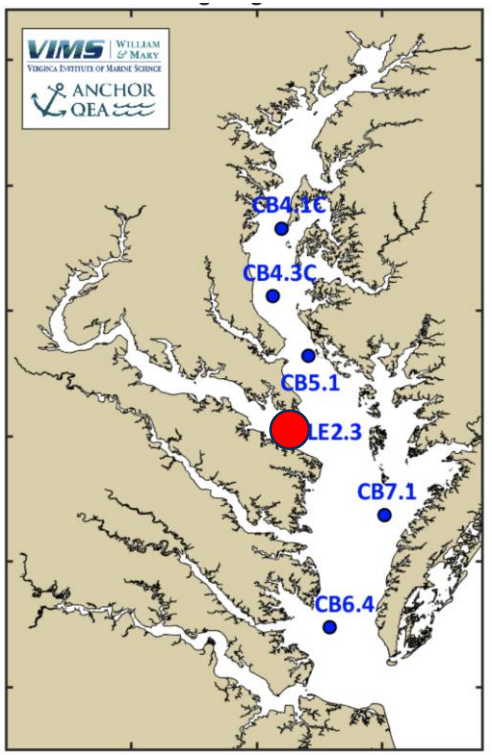


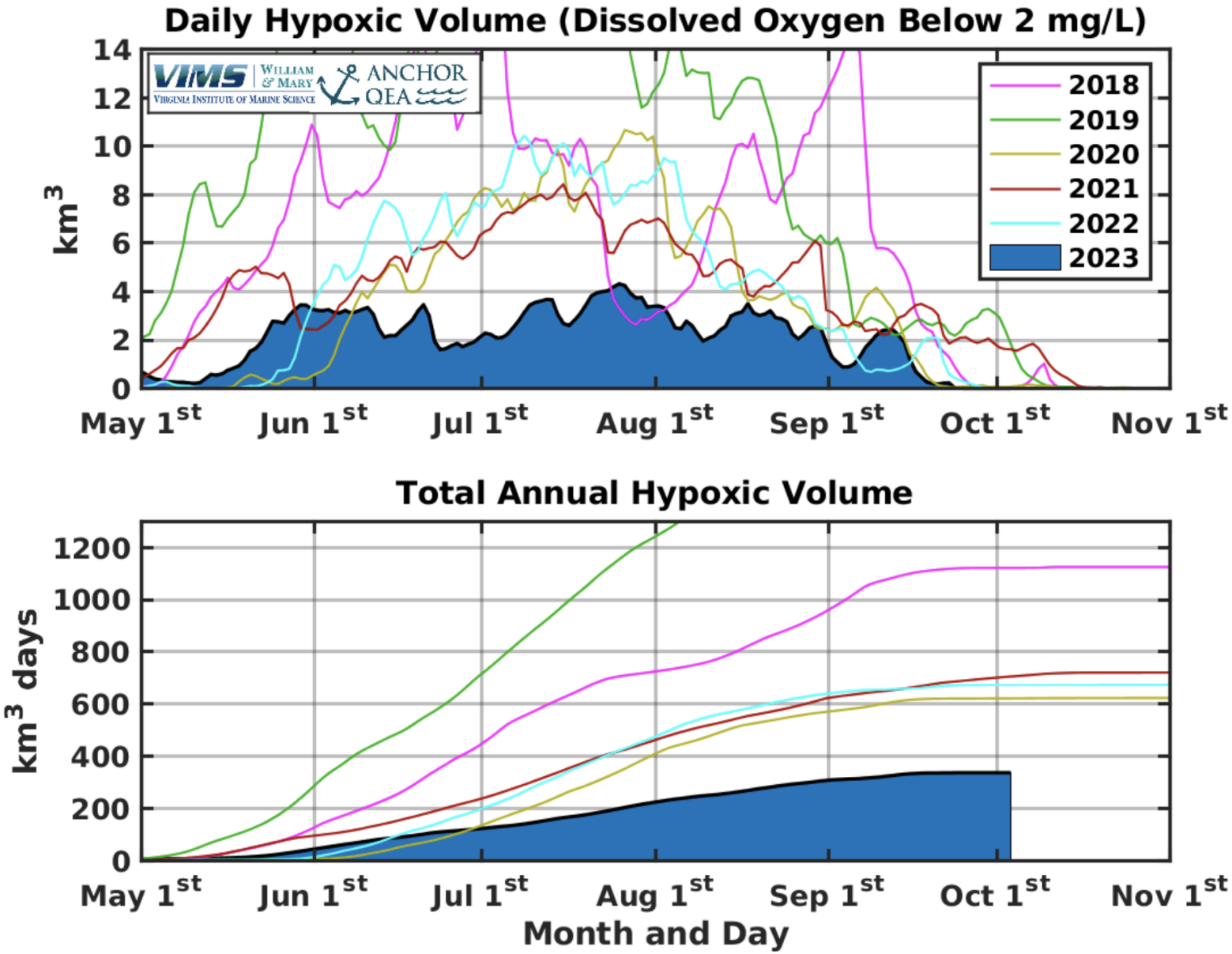
Vertical Profile Oxygen Data

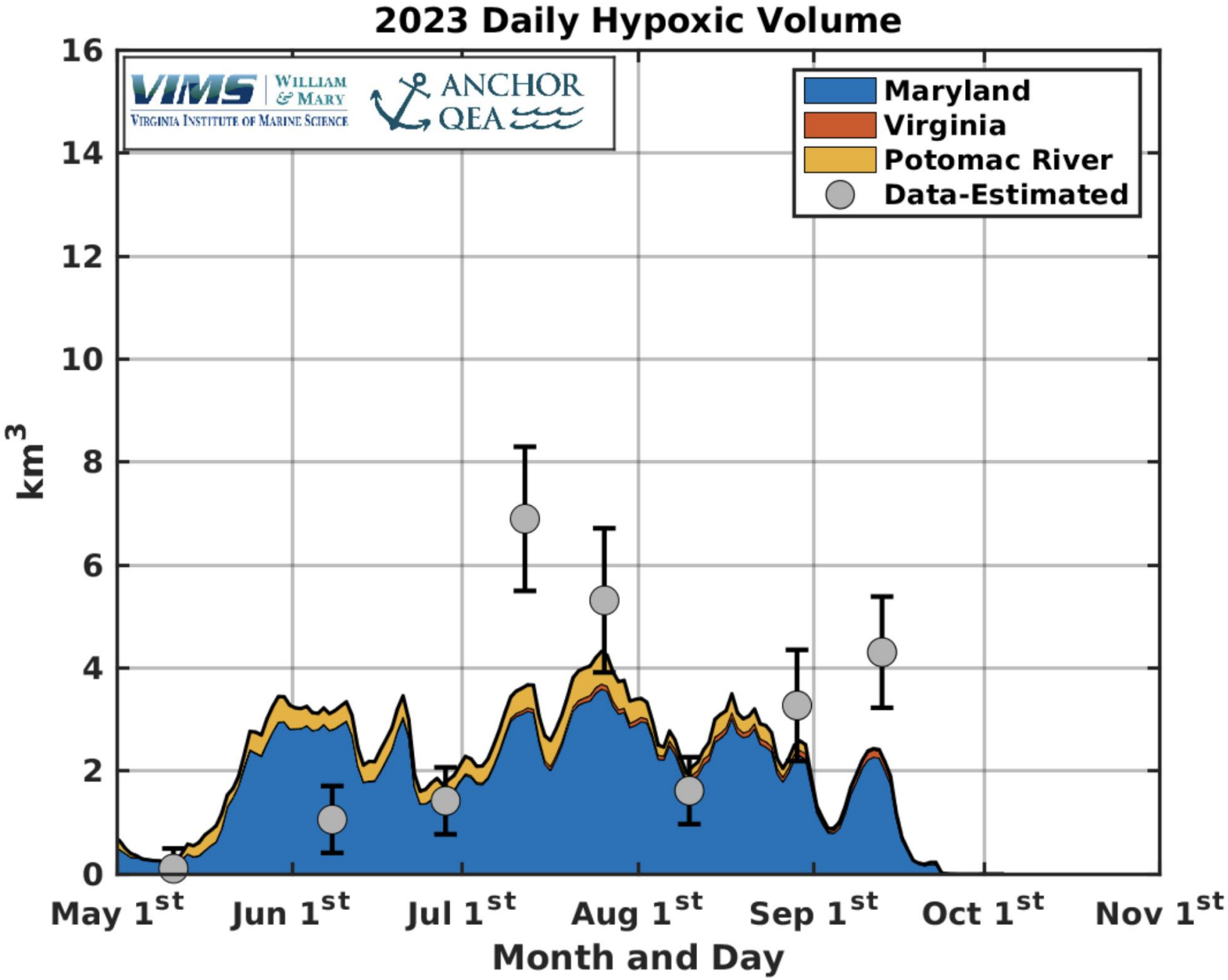


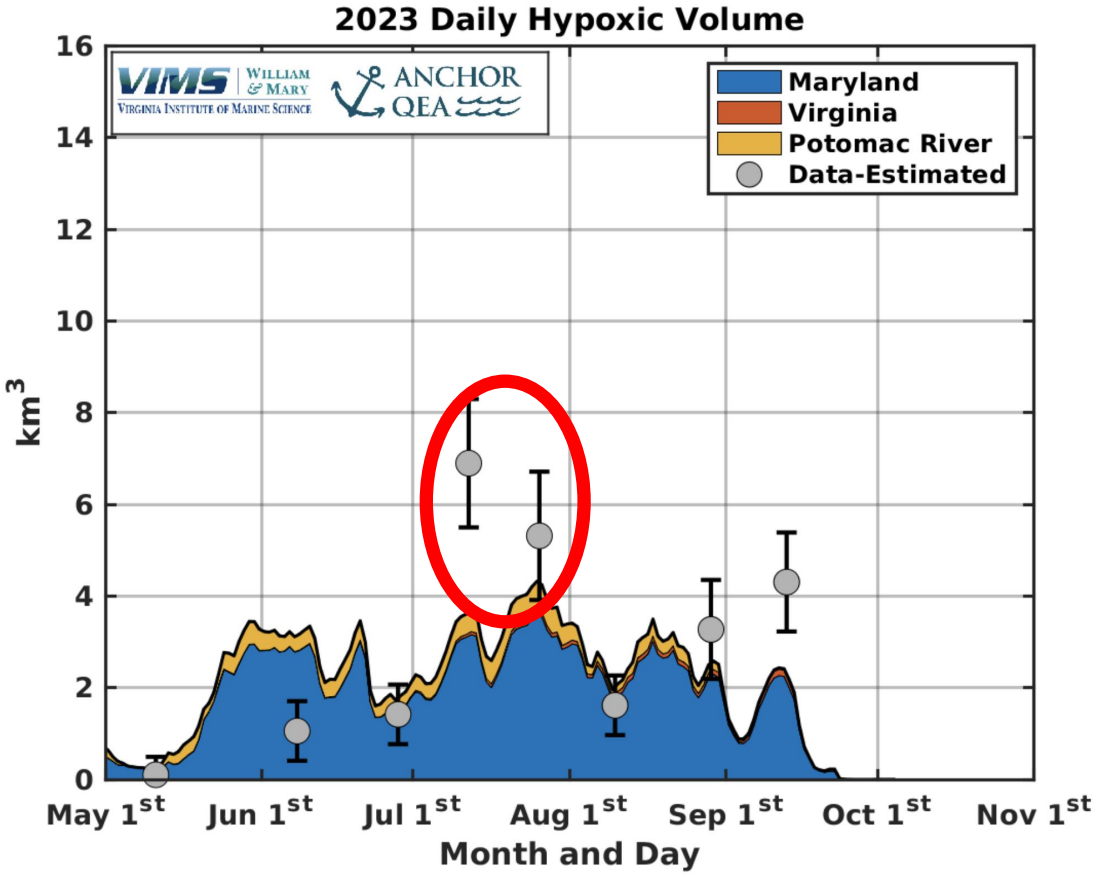
Lower Potomac



2024 Annual Hypoxia Report Card – Dead Zone Size




2023 Daily Hypoxic Volume
VIMS | William & Mary
Virginia Institute of Marine Science
ANCHOR QEA
Maryland
Virginia
Potomac River
Data-Estimated
km3
0
2
4
6
8
10
12
14
16
May 1st
Jun 1st
Jul 1st
Aug 1st
Sep 1st
Oct 1st
Nov 1st
Month and Day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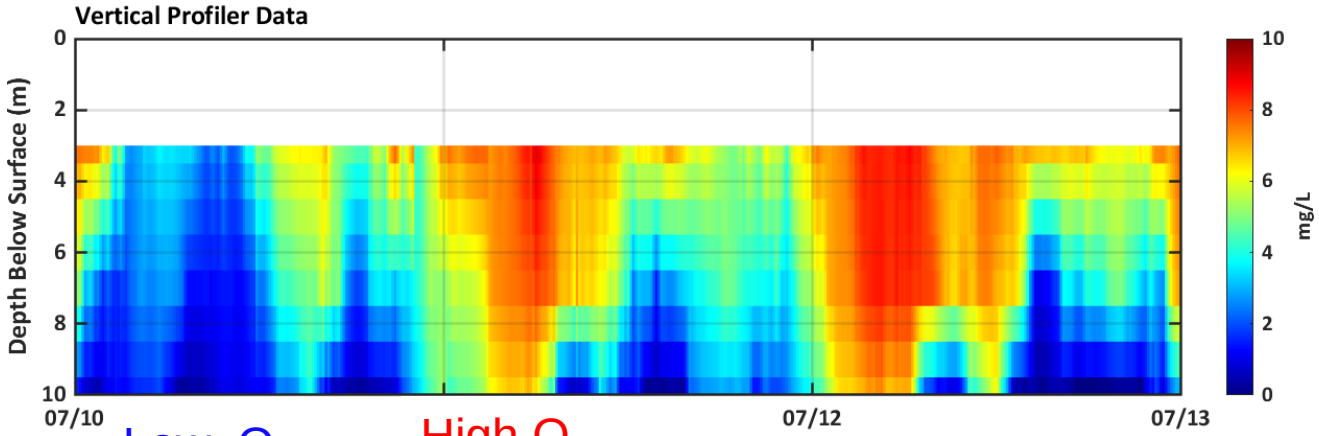
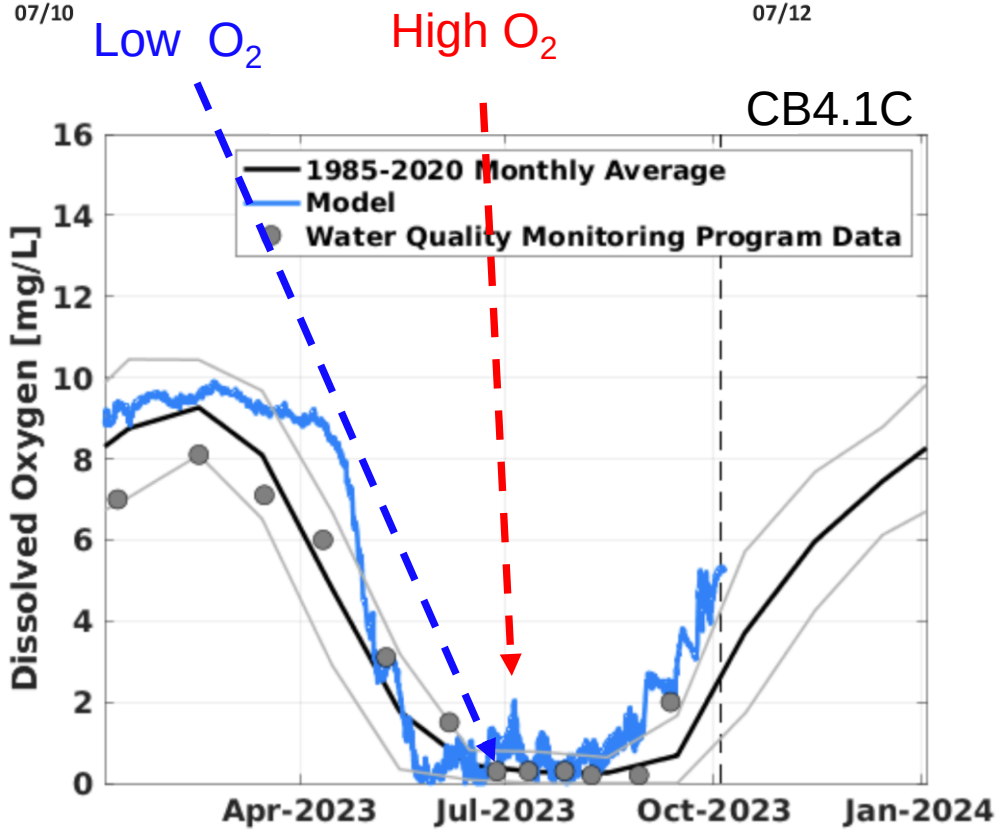
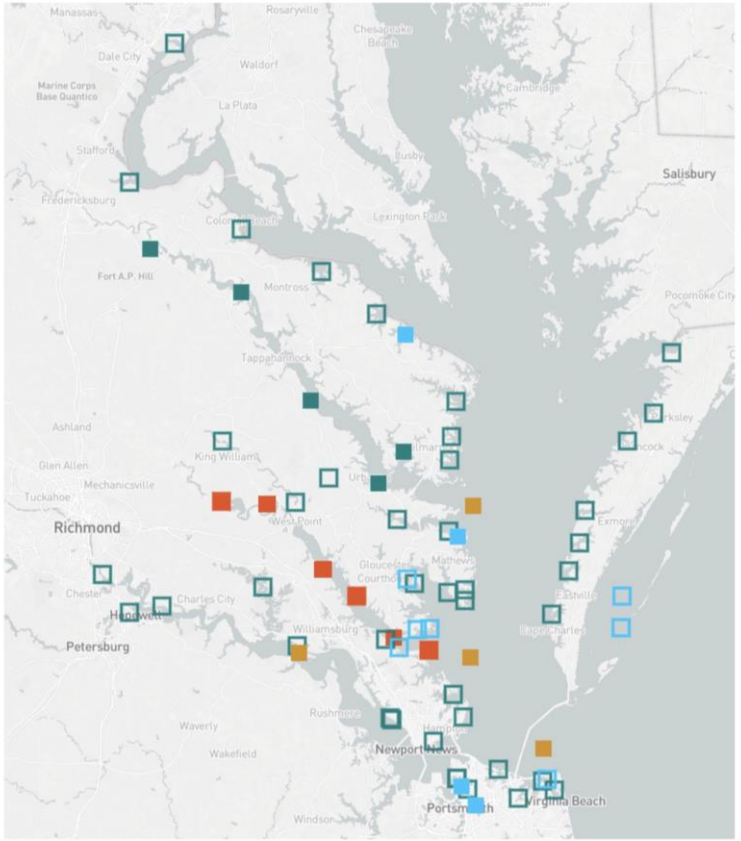

Vertical Profiler Data
Depth Below Surface (m)
0
2
4
6
8
10
07/10
07/12
07/13
mg/L
0
2
4
6
8
10


Low O2
High O2
CB4.1C
1985-2020 Monthly Average
Model
Water Quality Monitoring Program Data
Dissolved Oxygen [mg/L]
0
2
4
6
8
10
12
14
16
Apr-2023
Jul-2023
Oct-2023
Jan-2024

Summary

- Real-time vertical profile data provide an amazing opportunity to enhance modeling efforts, and put cruise data in context
  - Provide evidence of modeled high frequency bottom O_2 variability
  - Can help quantify uncertainty in interpolations (hypoxic volume) computed from biweekly/monthly sampling
- But only if we put stations in optimal locations!
  - Complement existing/past data
  - Where vertical structure is significant

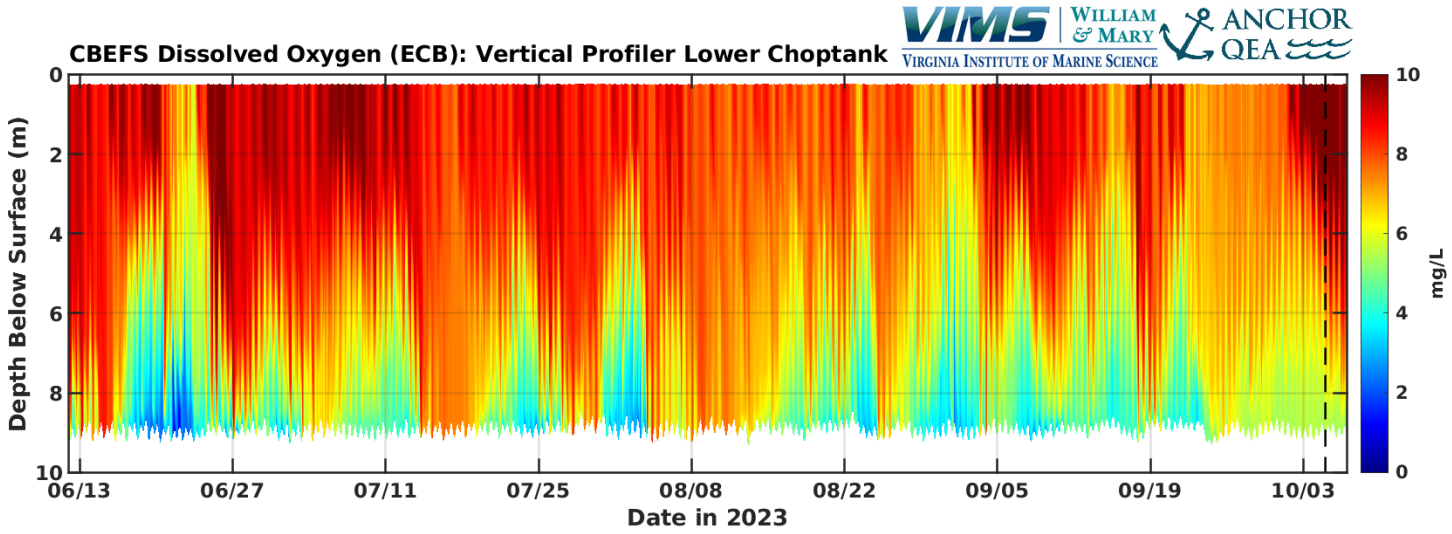


Data available at vecos.vims.edu

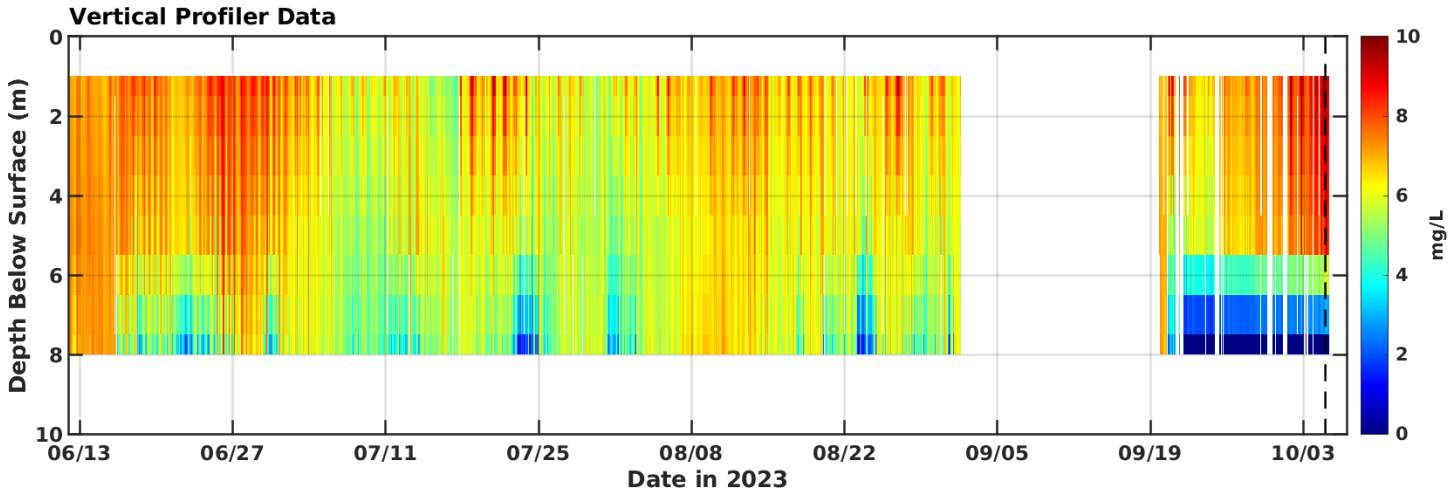
Source: CBNERR-VA 2023

CBEFS comparison with Vertical Profile Station data

CBEFS Oxygen



Vertical Profile Oxygen Data



Lower Choptank