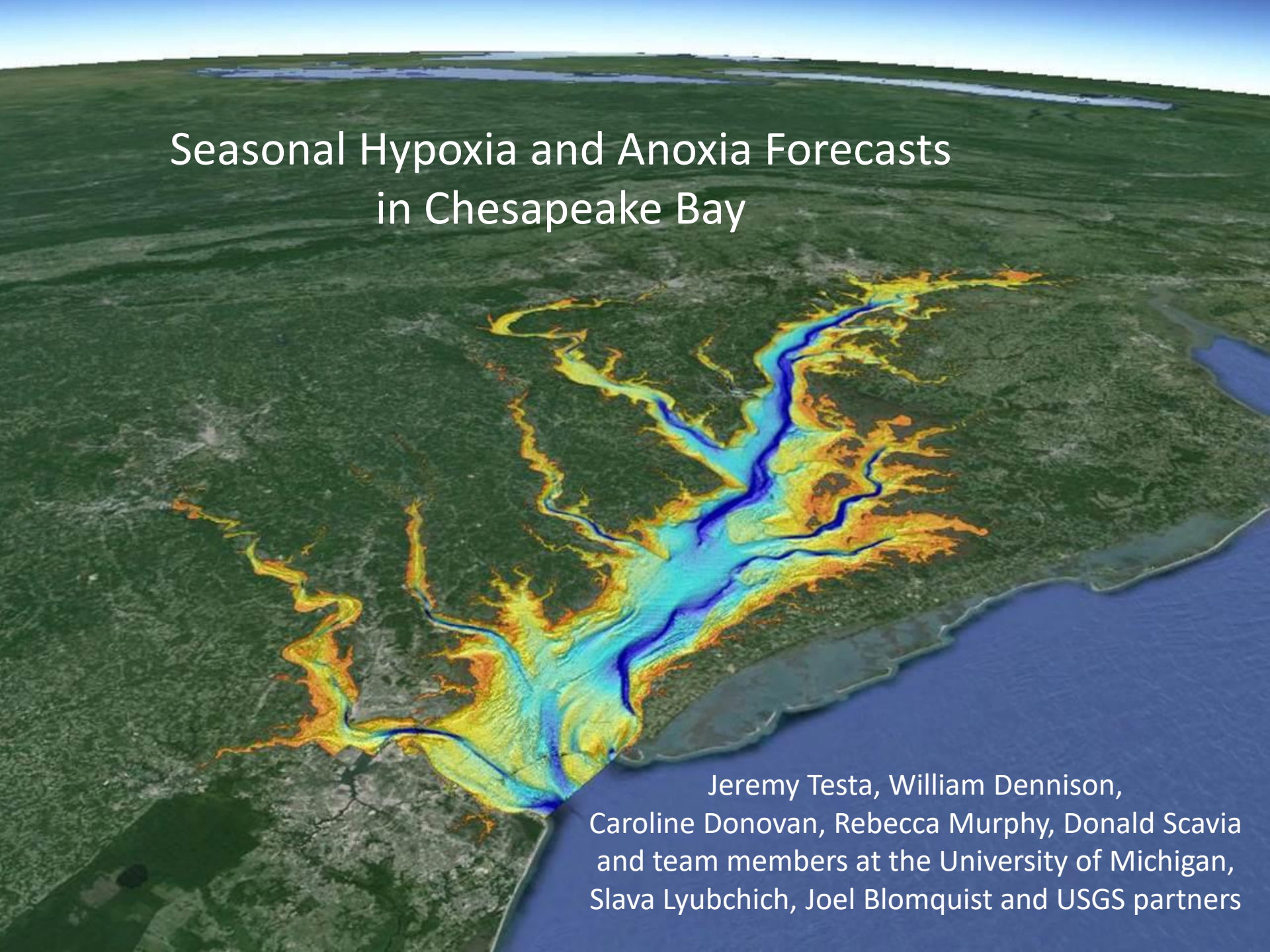
Seasonal Hypoxia and Anoxia Forecasts in Chesapeake Bay



Jeremy Testa, William Dennison,
Caroline Donovan, Rebecca Murphy, Donald Scavia
and team members at the University of Michigan,
Slava Lyubchich, Joel Blomquist and USGS partners

A Multi-Institutional Effort

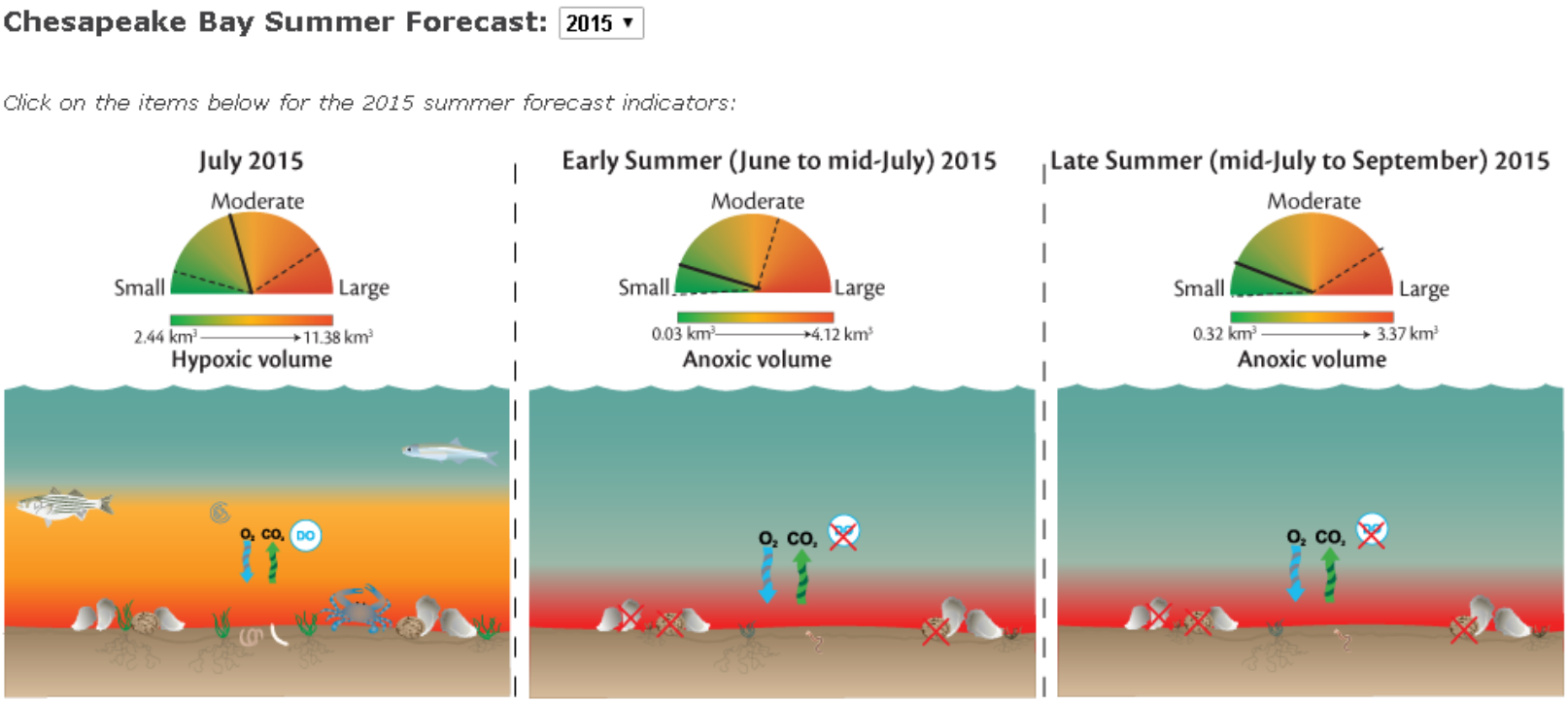
Jeremy Testa, Slava Lyubchich, William Dennison,
Caroline Donovan, Rebecca Murphy
University of Maryland Center for Environmental Science

Donald Scavia and his team
Graham Sustainability Institute, University of Michigan

Joel Blomquist, Bruce Michael, and many others at Maryland DNR, USEPA Chesapeake Bay Program USGS, NOAA, many past forecasters

Forecast Models

Three models have been used to forecast summer hypoxia and anoxia in Chesapeake Bay



July Average Hypoxia
$O_2 < 2$ mg/L

Early Summer
$O_2 < 0.2$ mg/L

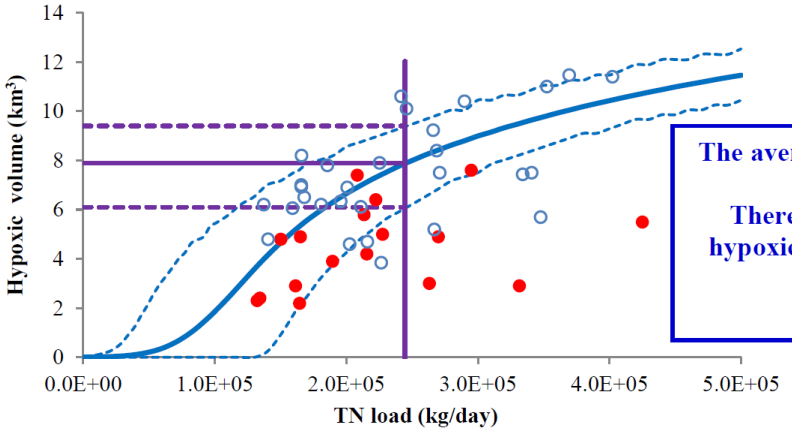
Late Summer
$O_2 < 0.2$ mg/L

- All models forecast hypoxia and or anoxia based on winter-spring nutrient inputs
- http://ian.umces.edu/ecocheck/forecast/chesapeake-bay/2017/
- Anoxia models are regression based, hypoxia model is a modified oxygen sag model
- Each fall, forecast is evaluated with a *Summer Review*

Two Models

Hypoxia

$$DO = DO_S - \frac{k_1 BOD_u(F)}{K * k_2 - k_1}\left(e^{-k_1\frac{x}{v}} - e^{-K*k_2\frac{x}{v}}\right) - D_i e^{-K*k_2\frac{x}{v}}$$



The average 2017 forecast is 7.9 km³.

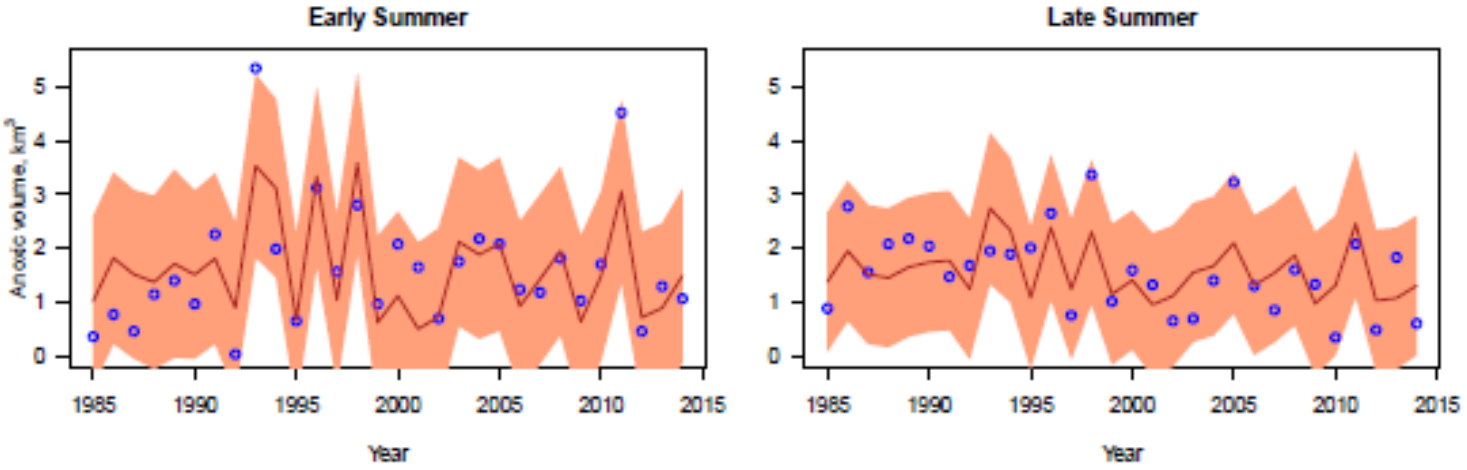
There is a 95% probability that hypoxic volume will be between 6.1 and 9.4 km³.

(Scavia et al.)

Anoxia

$$\text{Anoxic Volume}_{\text{early summer}} = b0 + b_1(\text{TN Load}_{JA}) + b_2(\text{RFlow}) + b_3(\text{MSL}) - b_4(\%\text{SE wind})$$

$$\text{Anoxic Volume}_{\text{late summer}} = b0 + b_1(\text{TN Load}_{JM})$$



Forecast Timeline

- Early June: USGS Provides Loads
- 1-5 days later, UMCES and UM generate forecasts
- Press release written, edited, and approved by participating agencies within ~7 days
- UMCES and UM Press Team develop release, solicit quotes and input from agencies
- Website Launched, Press Release Made:

  2015: June 23

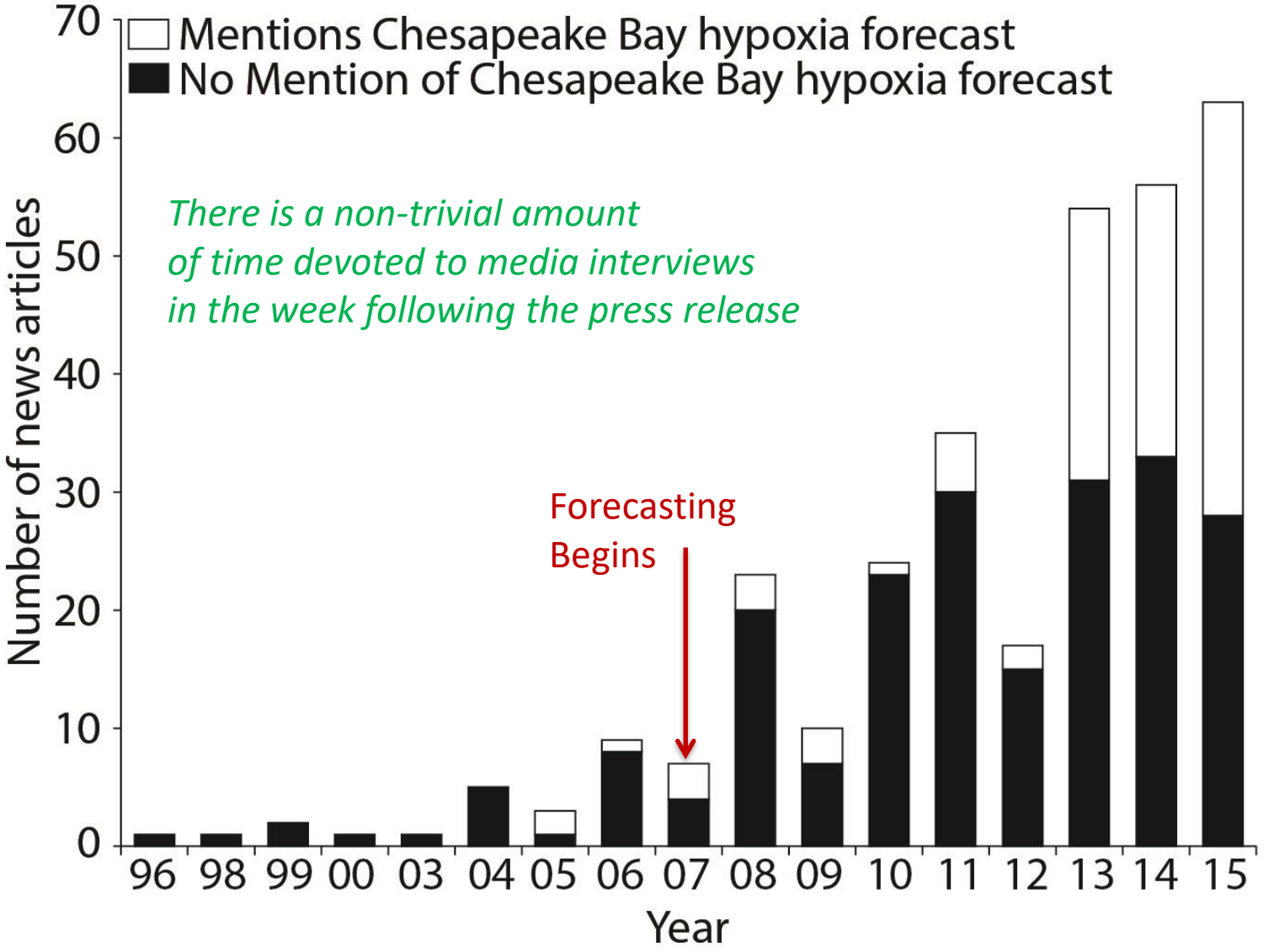
  2016: June 13

  2017: June 14

  2018: June ~18

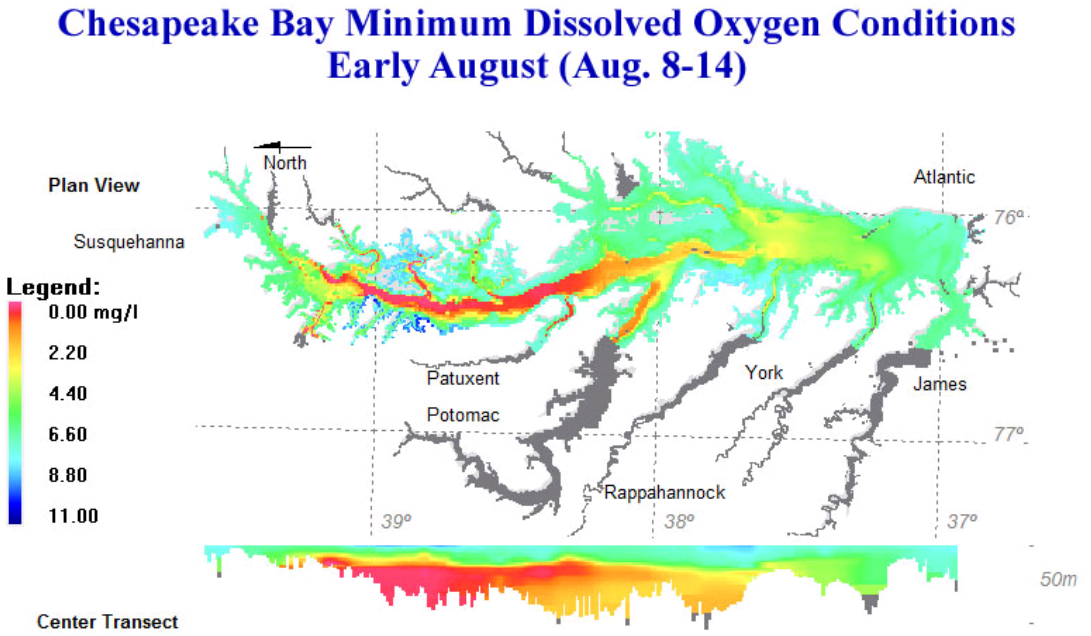
  2019: June 12

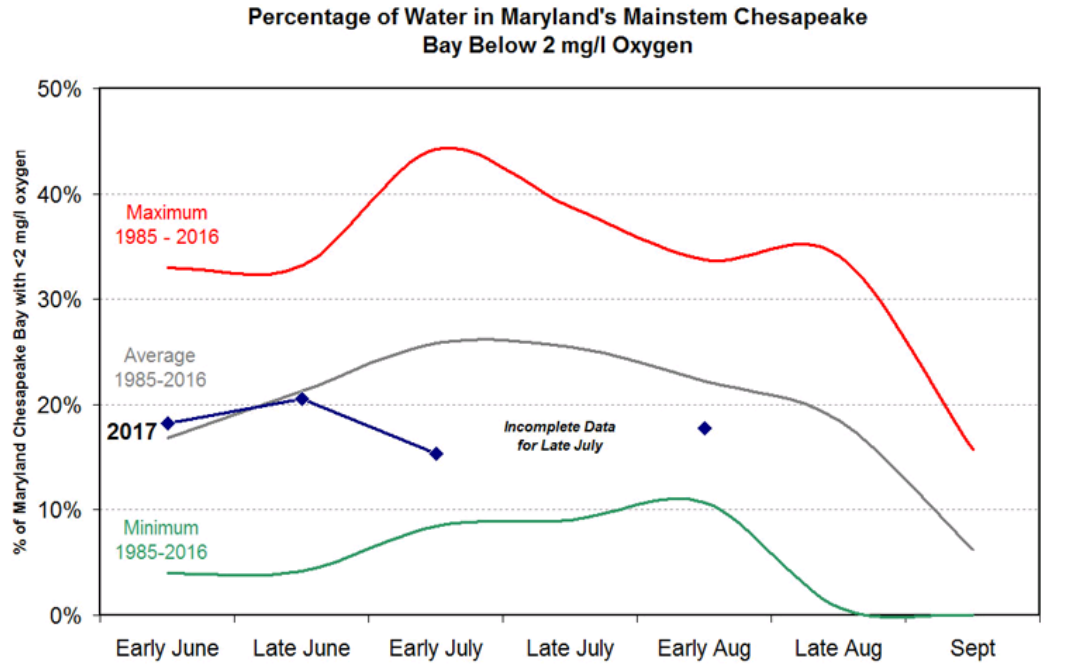
Increased Media Interest in Hypoxia and Forecasting



Assessment of Realized Hypoxia Throughout the Summer Refers to Forecast

- DNR Hypoxia Reports
- Should this effort be expanded?





A few quick thoughts:

- A single seasonal forecast may be better than multiple forecasts. Perhaps an ensemble of forecasts for the same metric?
- Past seasonal forecasts were not linked to habitat. They could be, but habitat is dynamic.
- We used to do a “Summer Review” of how the forecasts played out. We saw this as a teaching and learning moment. It received far less attention than the forecast.

Thank You