

The Application of Continuous Monitoring to Chlorophyll-*a* Criteria Derivation, Evaluation, and Implementation



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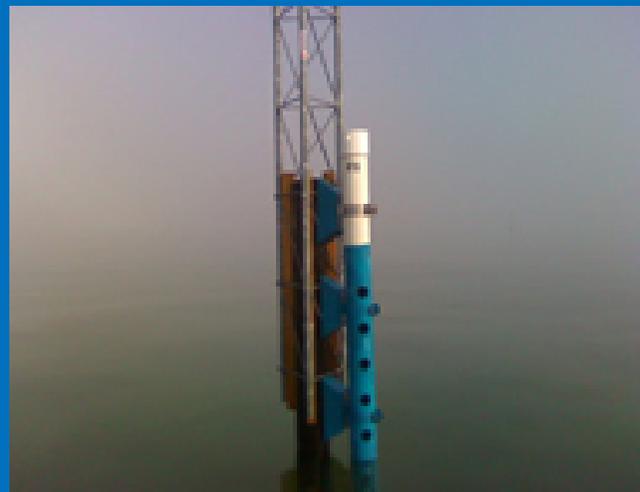
Kenneth Moore, VA Institute of Marine Science

Peter Tango, USGS Chesapeake Bay Program



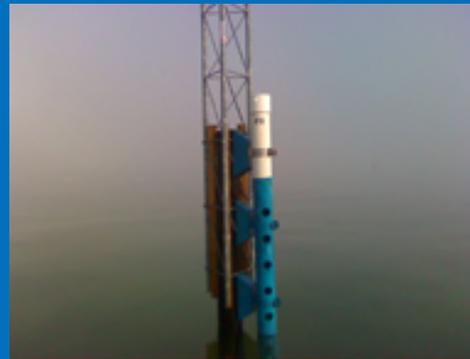
10th National Water Monitoring
Conference Tampa, FL
May 5, 2016

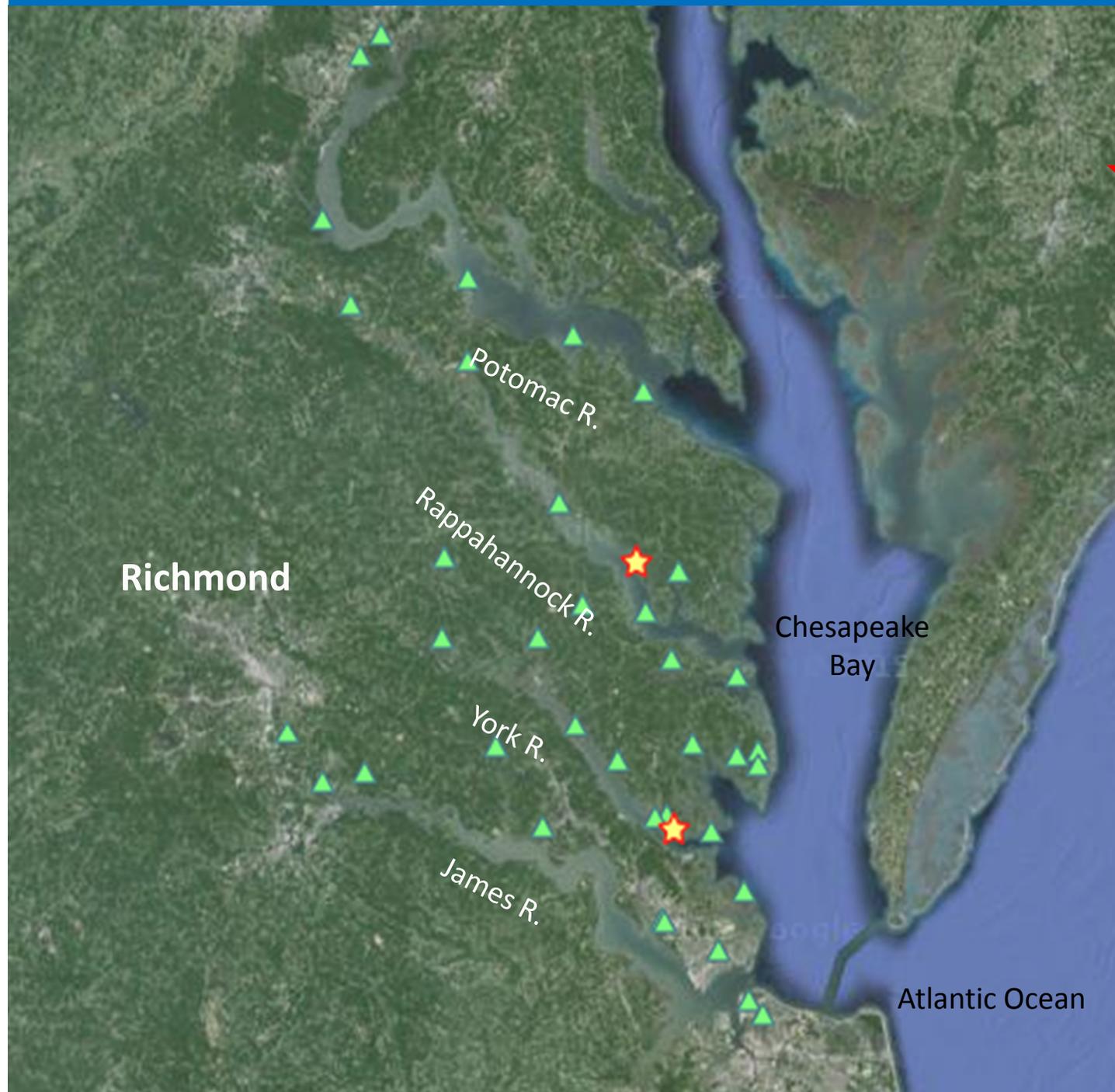
Virginia makes 303(d) listing decisions with ConMon data. These data are also being used to help refine assessment procedures of dissolved oxygen criteria in Bay waters.





Virginia's partnership with the Federal-Interstate Chesapeake Bay Program has provided it with a plethora of continuous monitoring datasets.

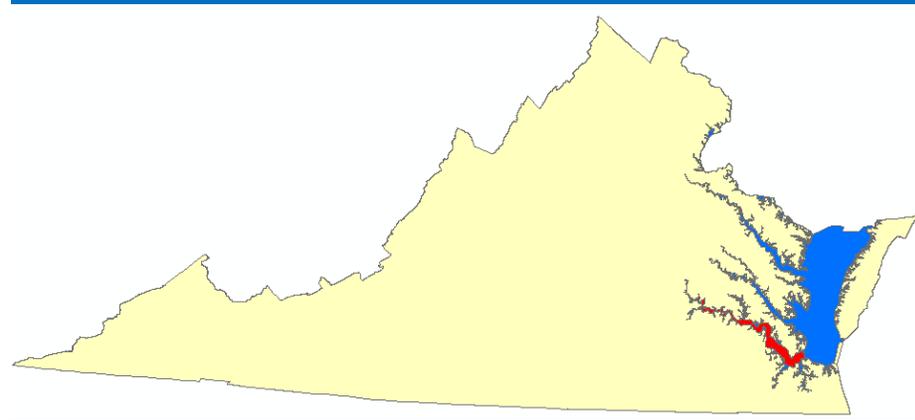




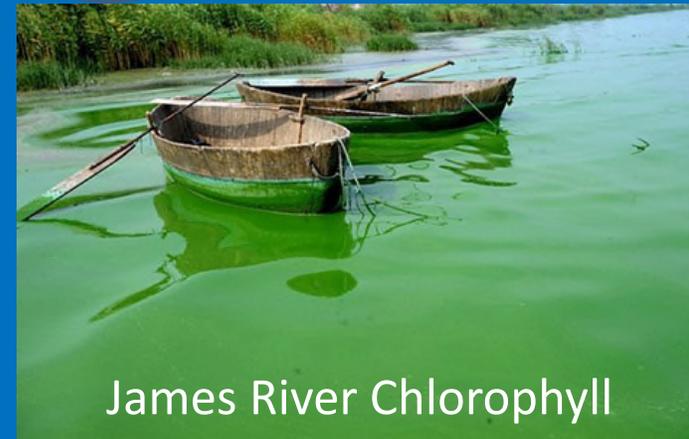
-  36 Surface, Near-Shore ConMons
-  2 mid-channel Vertical Profilers

Key Features:

- Three-year Mar-Oct deployments
- pH, DO, turbidity, fluorescence
- One monitor per salinity regime per estuary



We really should
be using ConMon
data to inform
water quality
standards!



James River Chlorophyll

Harmful physicochemical effects of algal blooms

- Elevated pH
- Reduced water clarity
- DO supersaturation
- Hypoxia

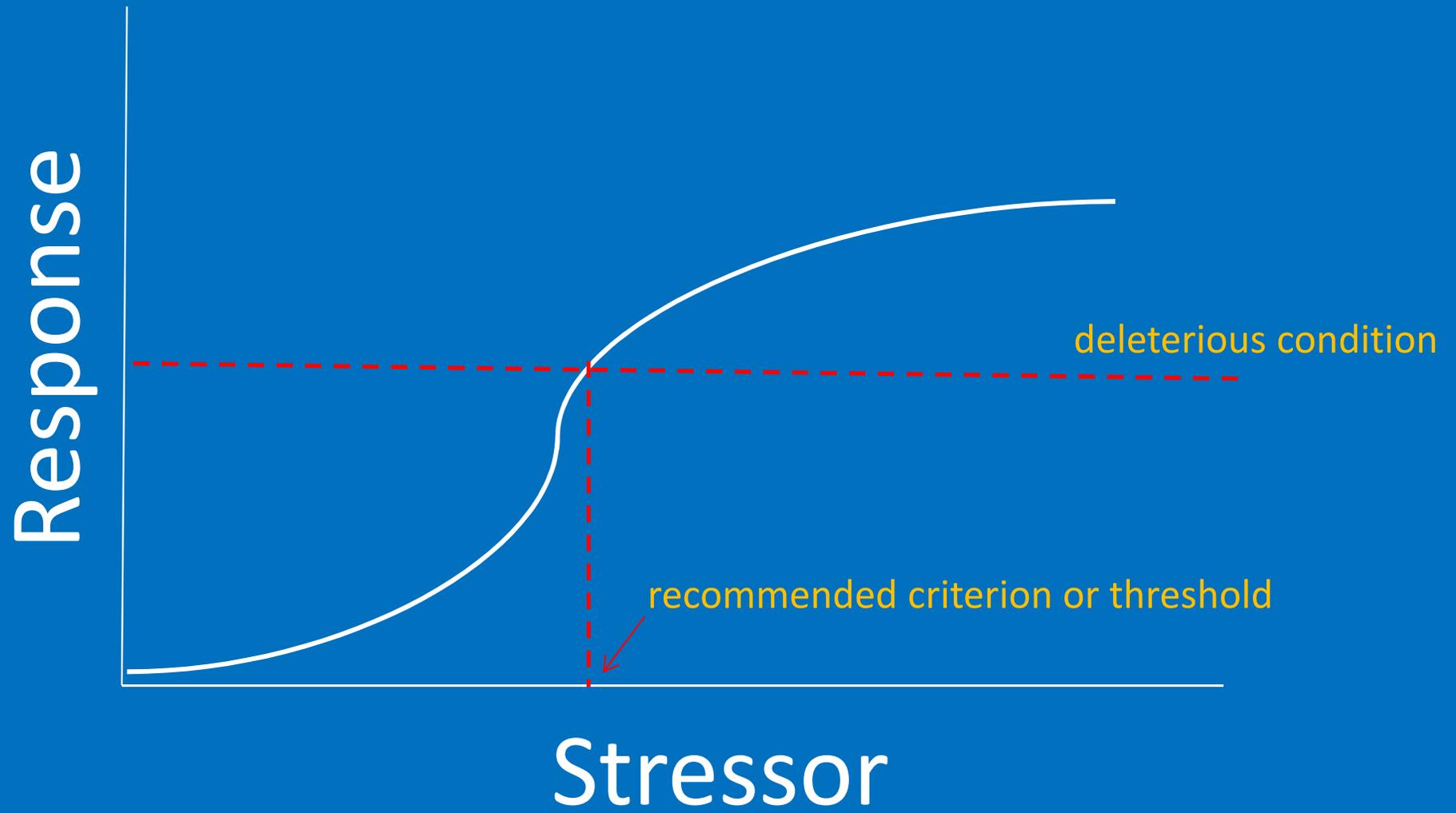


Continuous monitoring instruments are well-suited for capturing deleterious conditions caused by excessive algae growth.

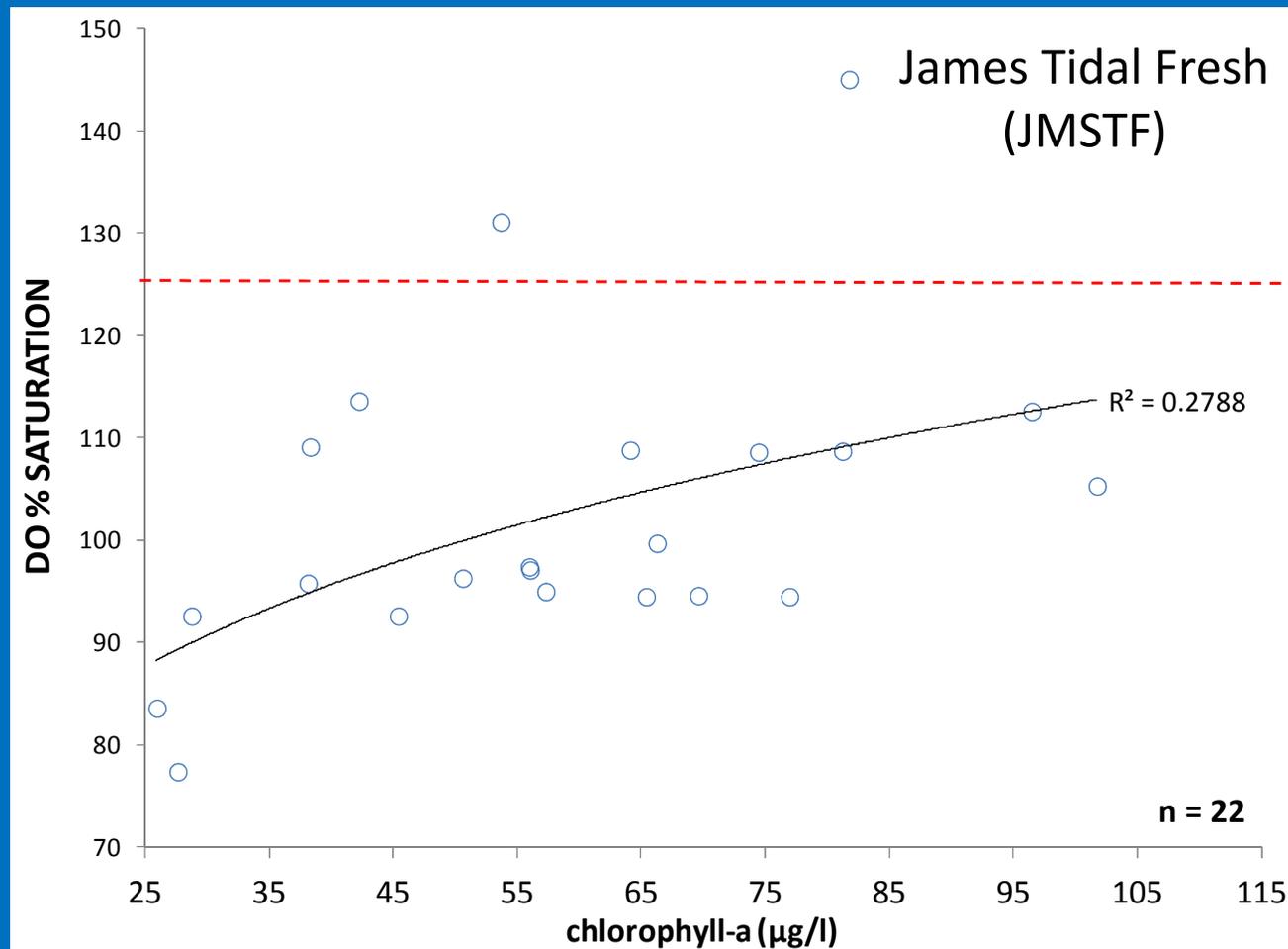


ConMon Advantage #1

ConMon allows for sophisticated stressor-response curves.



A stressor-response curve based on discrete samples



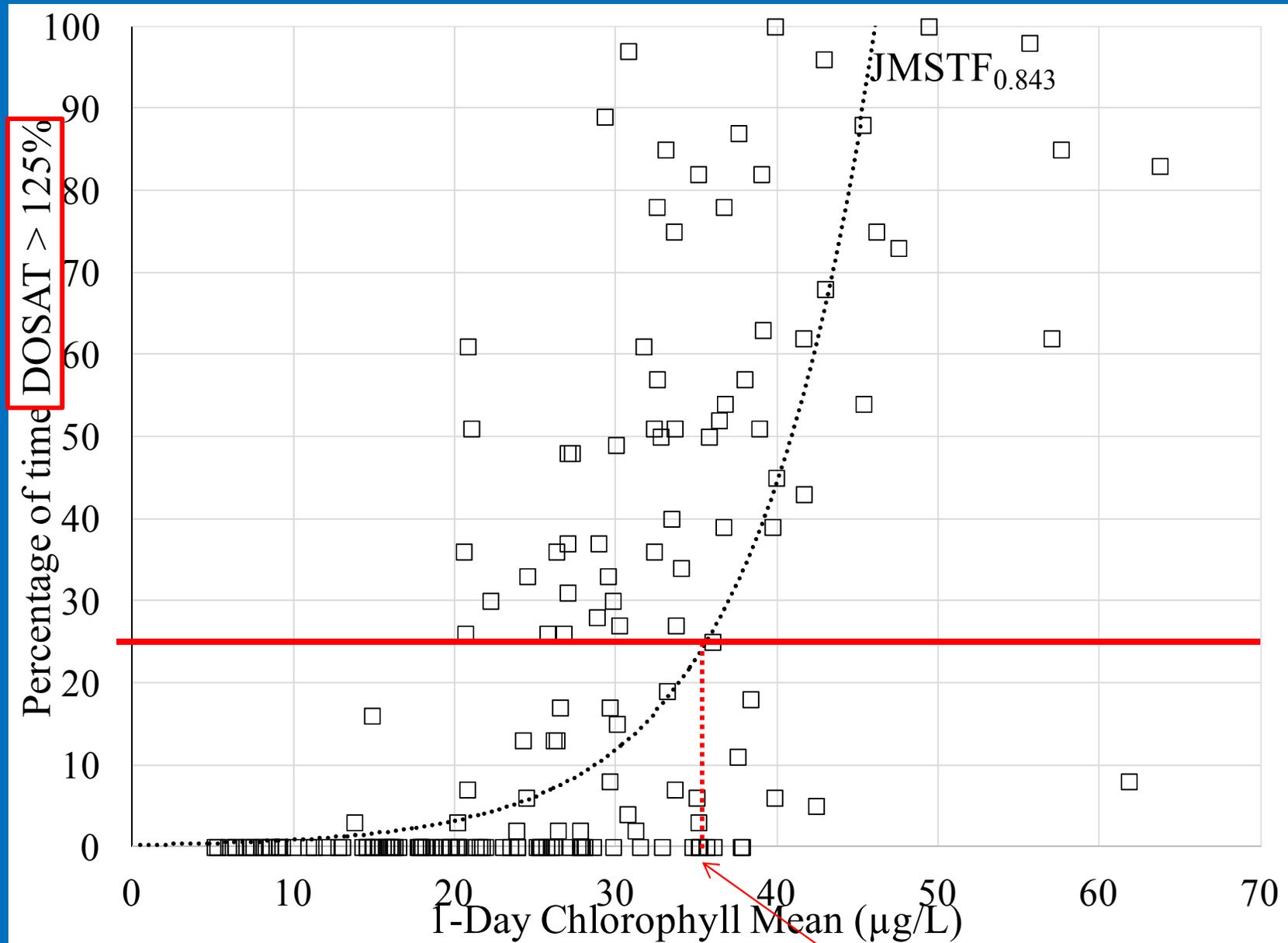
Is there a low occurrence of harmful condition in this waterbody?

Or is semi-monthly monitoring not adequate for capturing harmful conditions in this waterbody?

Non-linear regression model fit

A stressor-response curve based on ConMon data

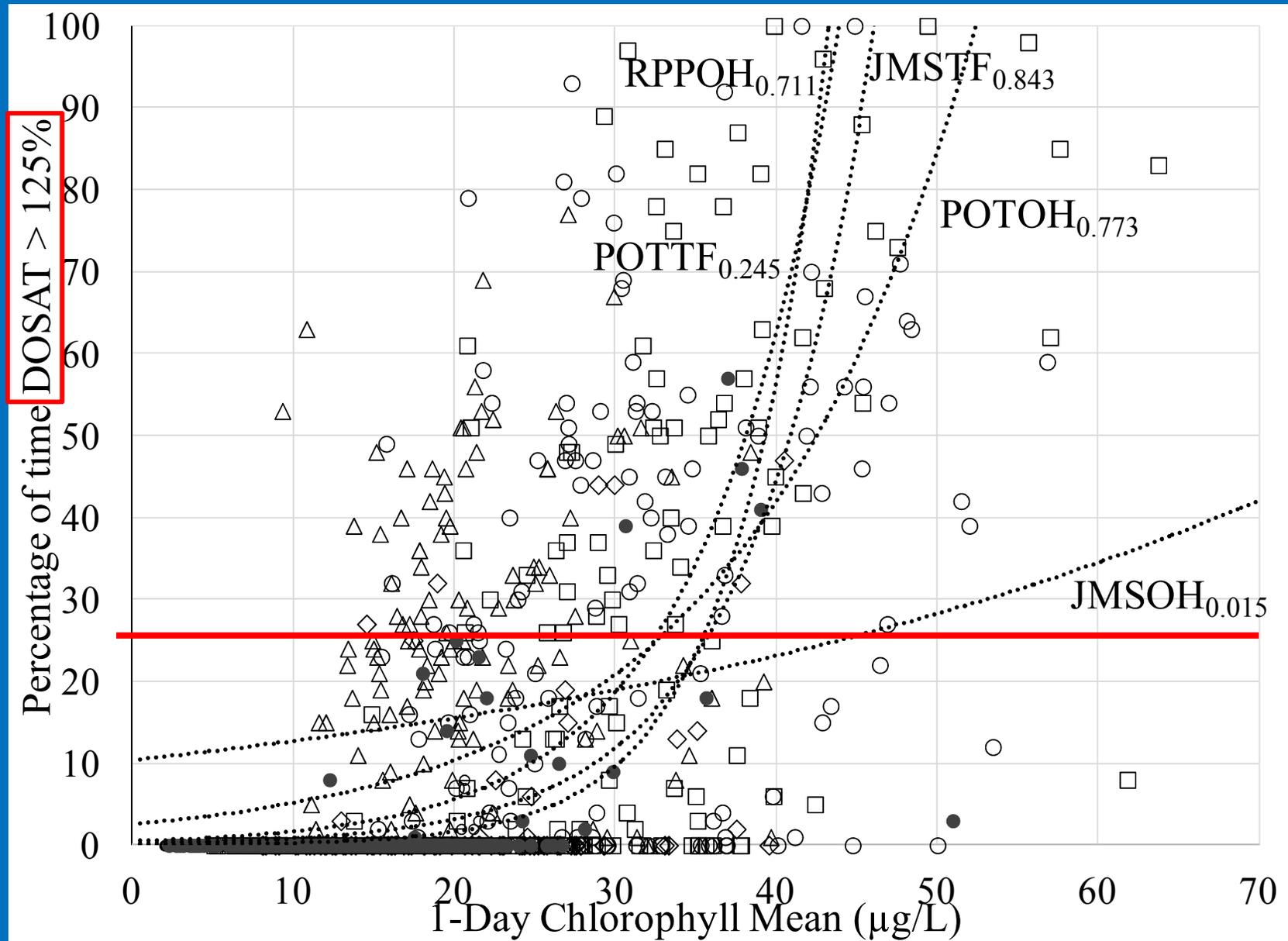
DO supersaturation in the James Tidal Fresh



Negative binomial regression model fit

Chla Threshold = 37 µg/l

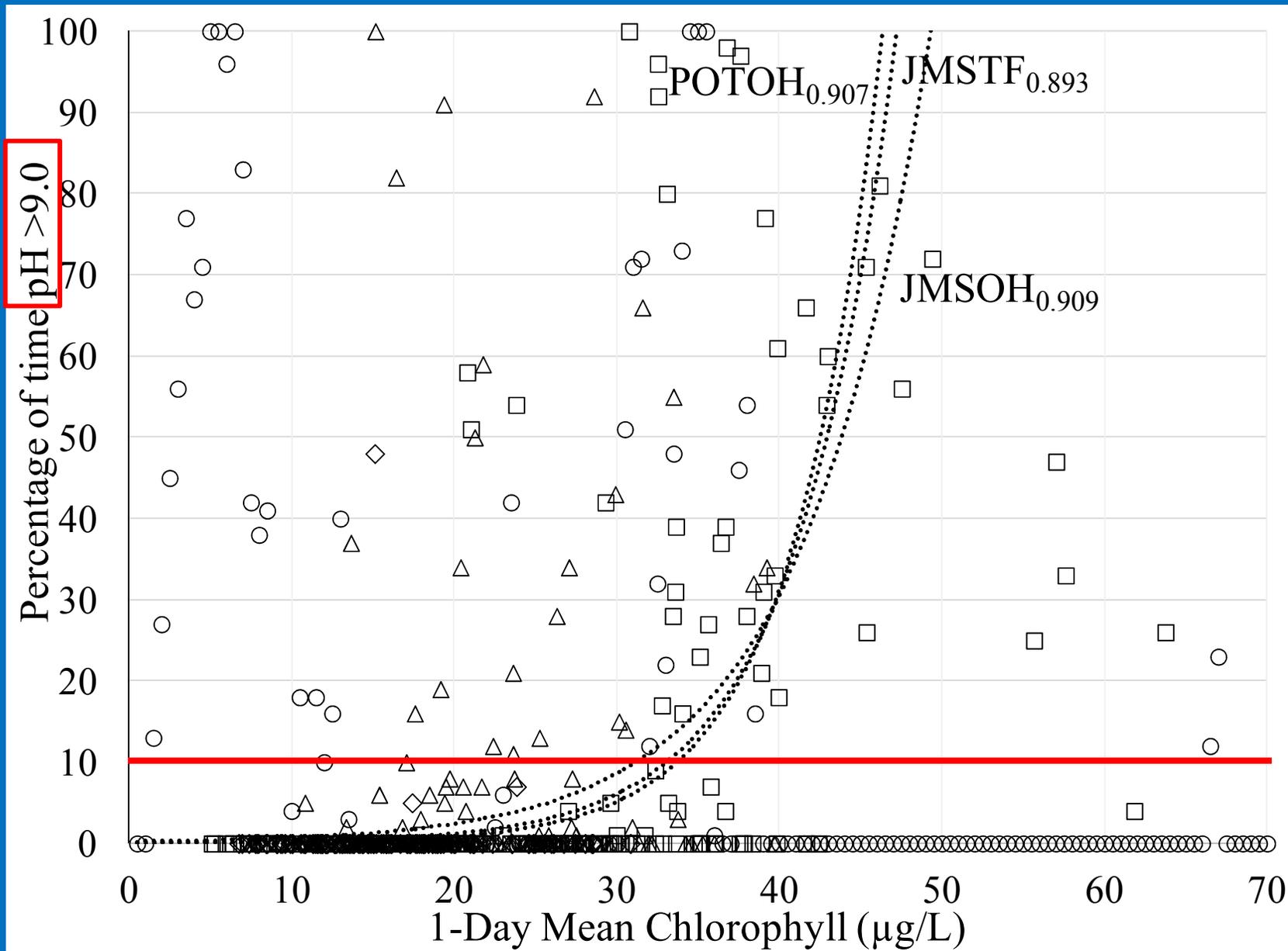
DO supersaturation (multiple sites)



Negative binomial regression model fits

□ JMSTF △ JMSOH + RPPTF ● RPOH ◇ POTTf ○ POTOH

Elevated pH

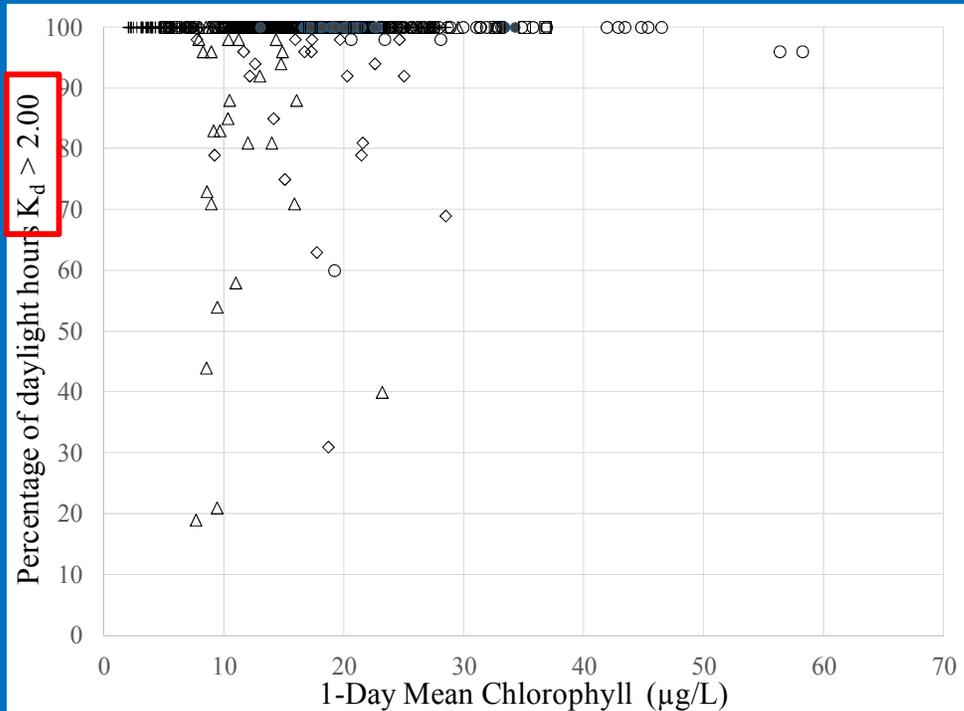


Elevated pH is not evident at all eutrophic sites.

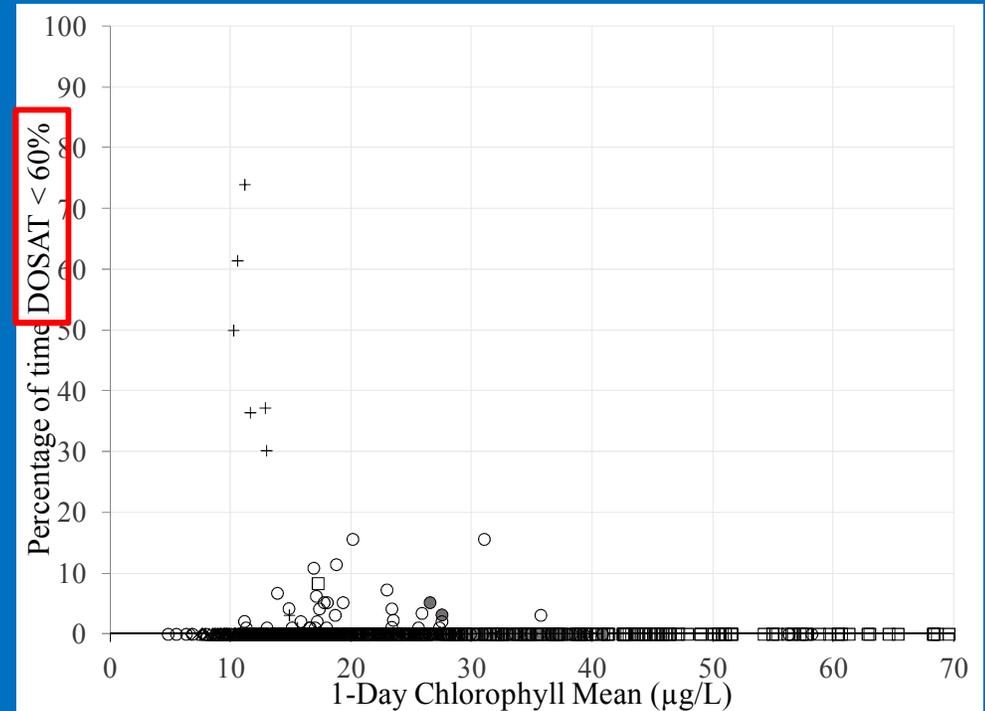
Negative binomial regression model fits

\square JMSOH \triangle JMSOH $+$ RPPTF \bullet RPPOH \diamond POTTF \circ POTOH

Water Clarity



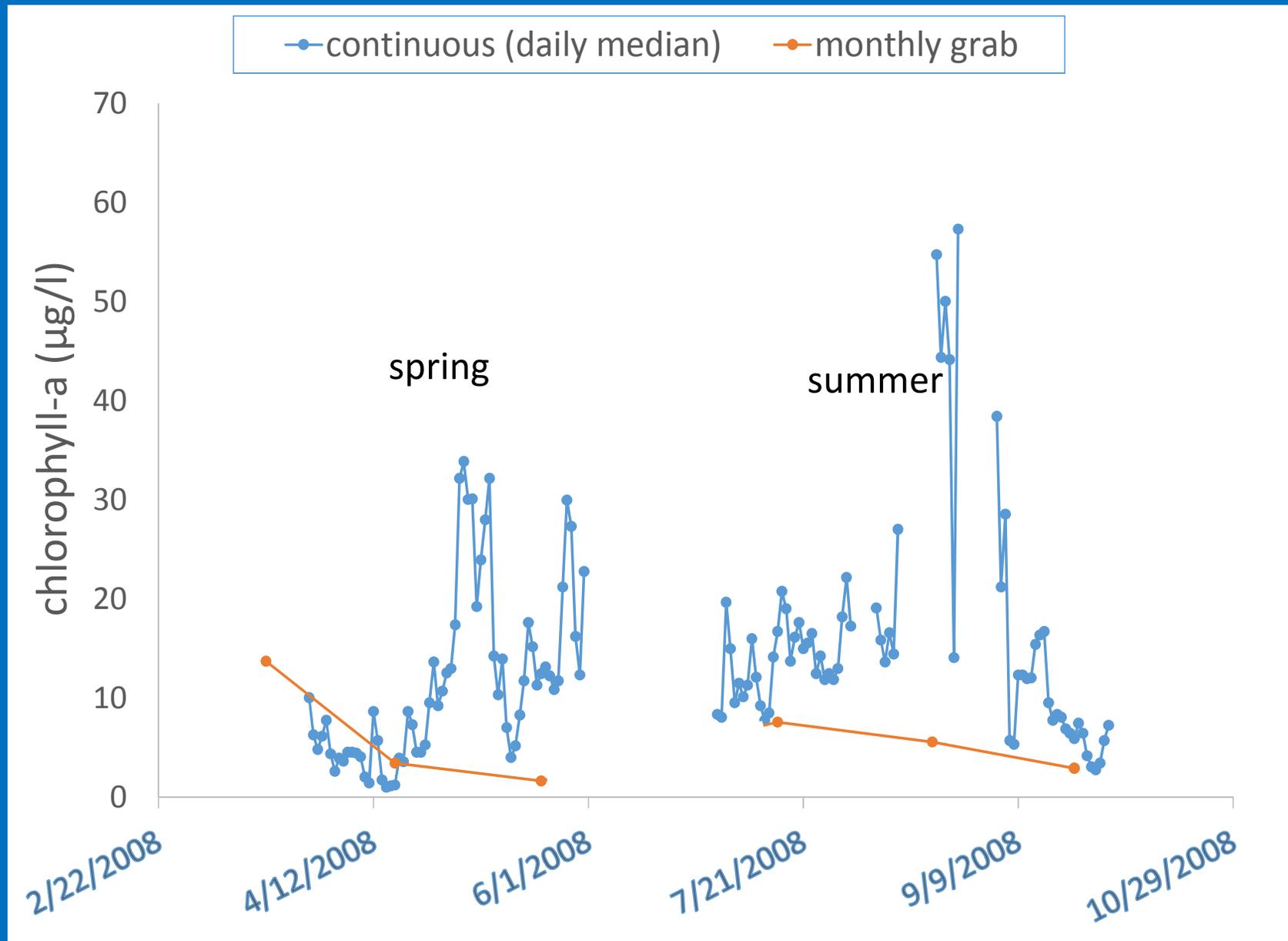
Hypoxia



ConMon can't "capture" all relationships, though.

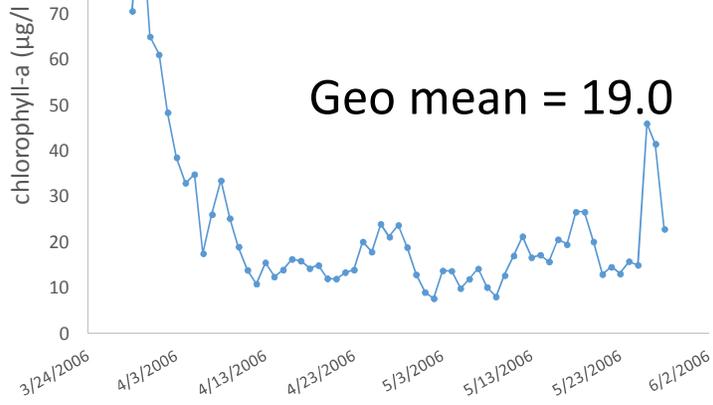
Advantage #2

ConMon allows for precise characterization of temporal variability. This is important for seasonal or annual criteria derivation.



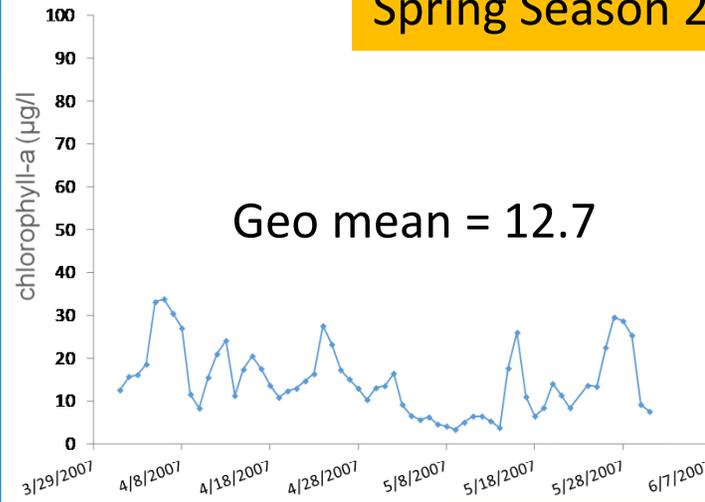
Continuous and discrete monitoring datasets tell different stories about what happened over a season or year.

Spring Season 1

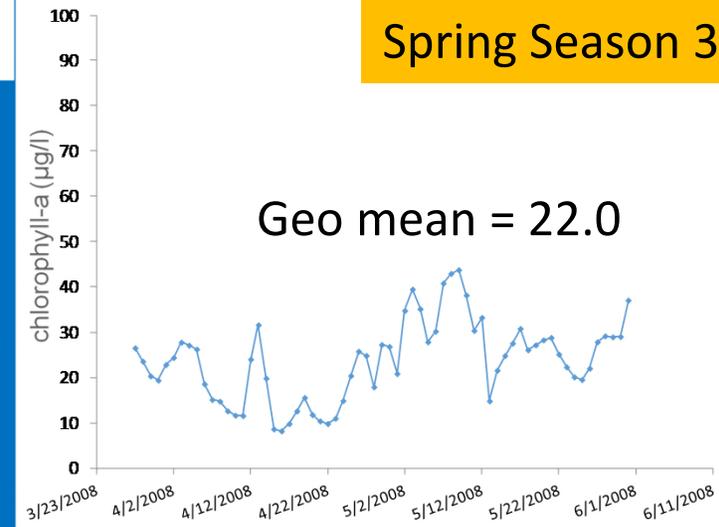


ConMon can also capture inter-annual or -seasonal variability

Spring Season 2

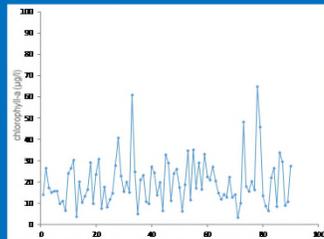
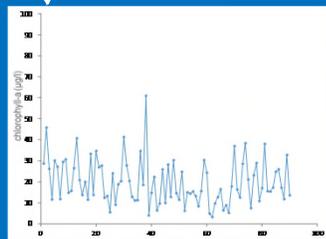
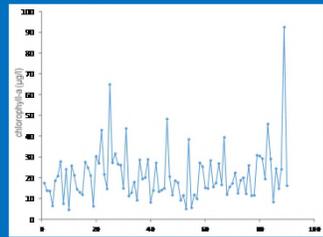
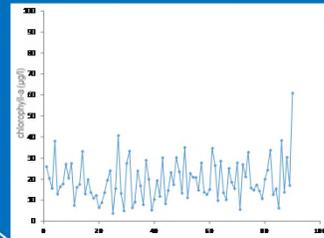
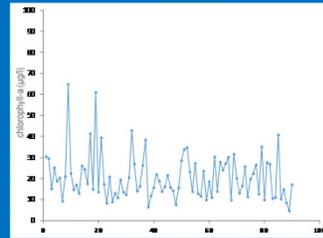
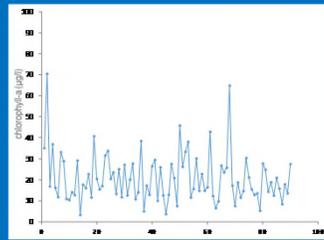
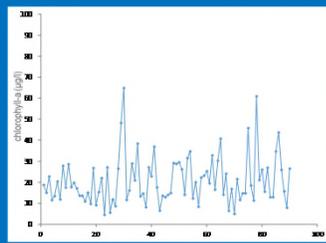
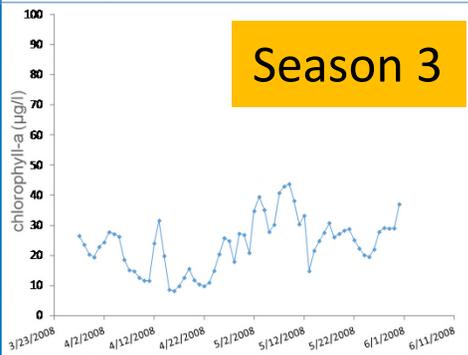
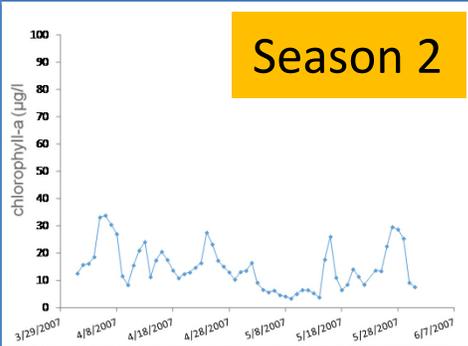
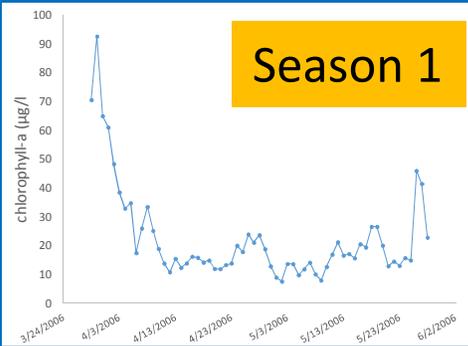


Spring Season 3



What can we do
with just three
years of data?!

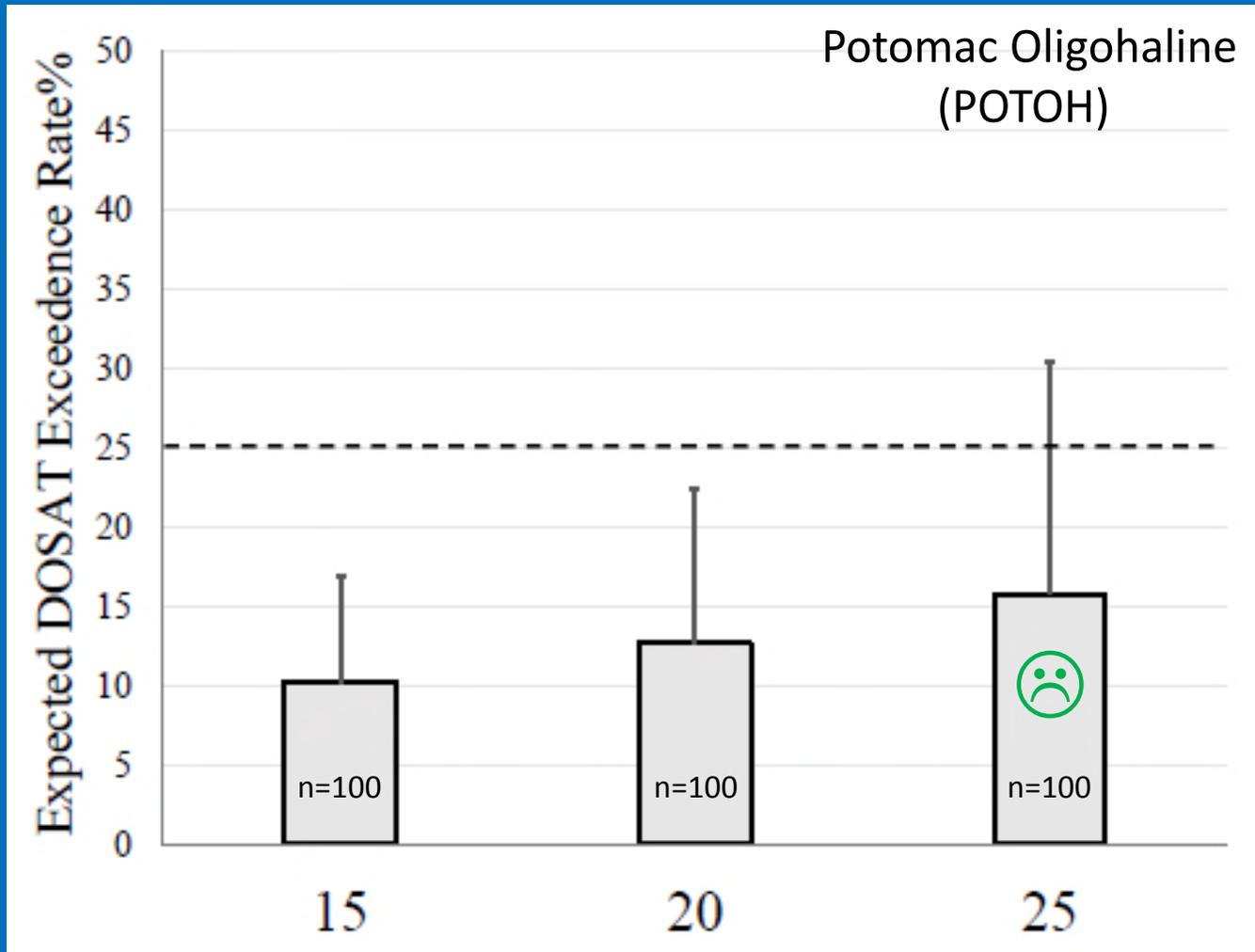




Original ConMon dataset

Bootstrap sampling of original dataset to simulate different seasons

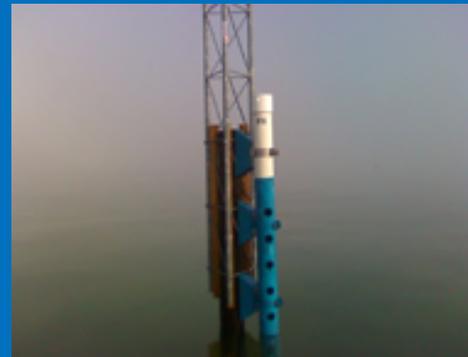
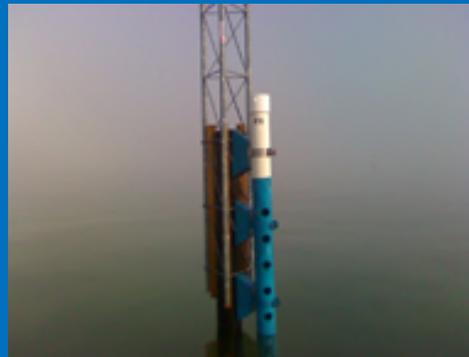
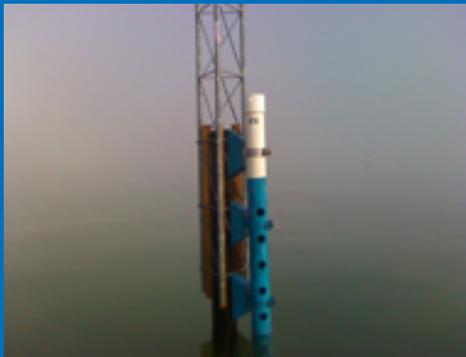
- Group simulated datasets by central tendency.
- Use predictions from stressor-response curve to estimate overall physicochemical condition for the simulated season.
- The highest central tendency associated with a low risk of physicochemical harm is a good candidate for a seasonal criterion.



Bad candidate
for a seasonal
criterion!



Questions?



Download ConMon datasets at www.vecos.org