Analysis of Attainability
Methodology Discussion

Water Quality Advisory Committee

May 18, 2022

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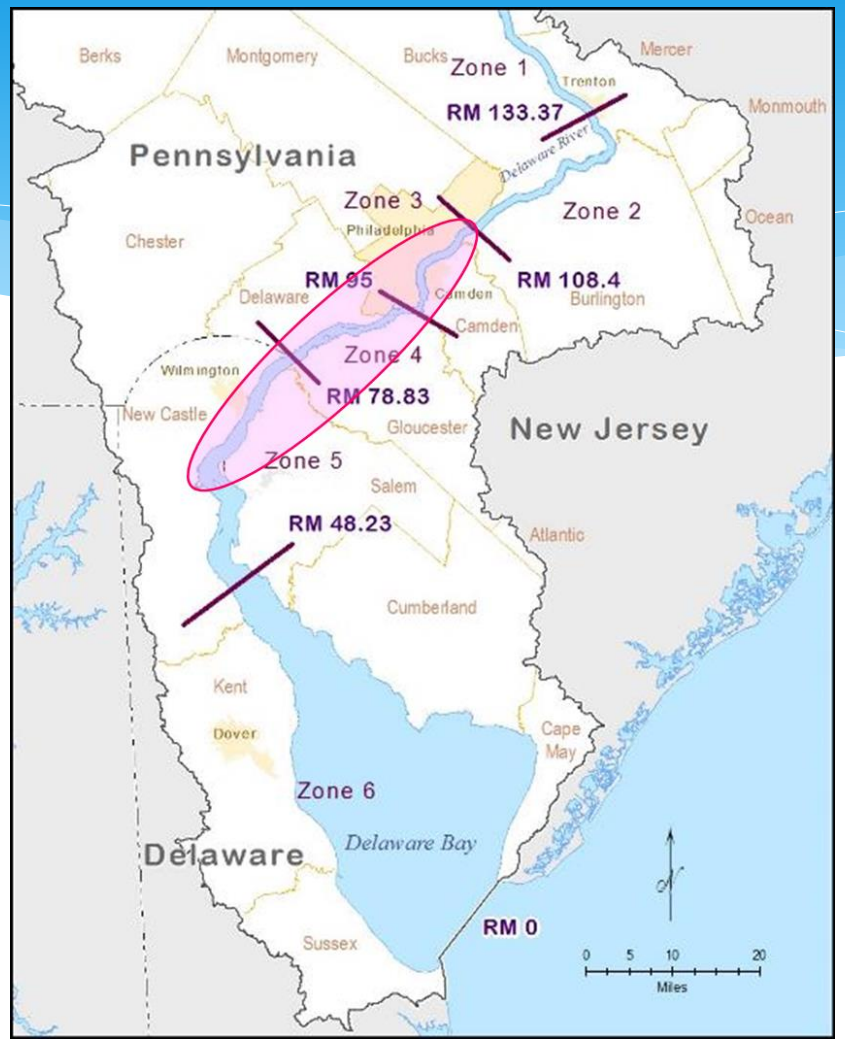
Purpose of "Analysis of Attainability"

- How much can the dissolved oxygen (DO) condition be improved?
  - How sensitive is the DO condition to various source categories?
  - What would the DO condition be under various levels of point and nonpoint source pollutant reductions?
  - What would be the costs and benefits associated with the various point and nonpoint source reductions?
- DRBC will determine the Highest Attainable Dissolved Oxygen (HADO) condition



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Elements of "Analysis of Attainability"

Core modeling elements

- Design condition
  - Existing loads under critical conditions
  - Provides a baseline against which to compare future scenarios
- Test Scenarios
  - Source sensitivity scenarios
  - Load reduction scenarios
- Metrics to compare scenarios
  - Basis to compare one scenario with another
  - Dissolved oxygen metrics

Subsequent elements for future discussion

- Selection of candidate scenarios
- Characterization of costs and benefits
  - Systemwide characterization
  - Benefits can be characterized based on DO improvement and increase in estuary value
- Affordability evaluation
  - Facility-specific
  - May influence scenario selection and/or compliance schedule

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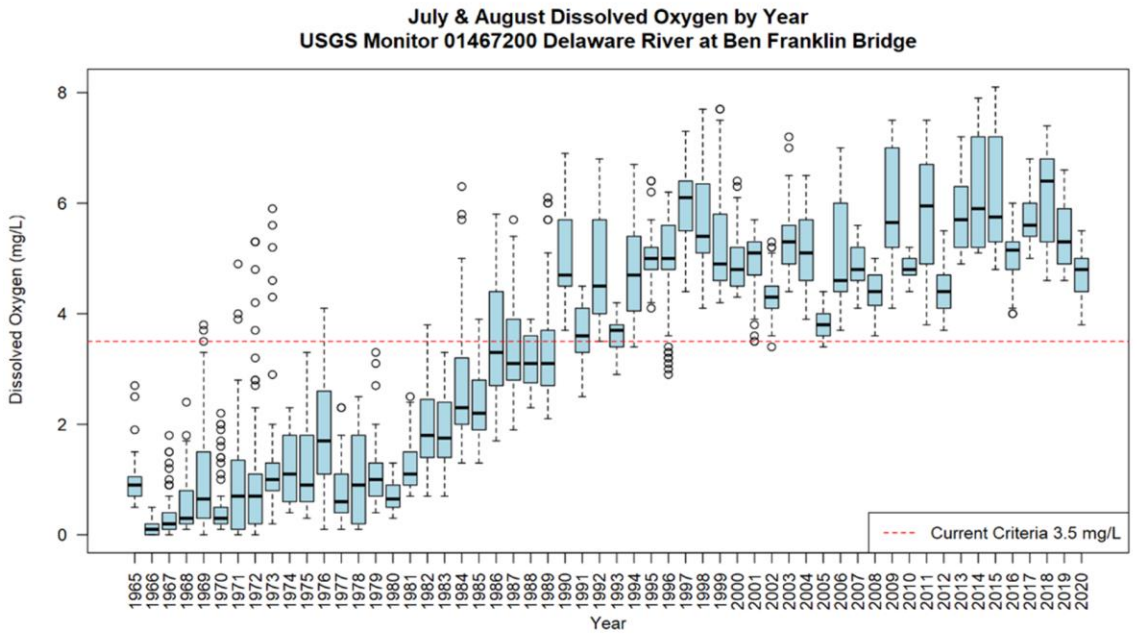
Analysis of Attainability Methodology under development

Historical Perspective



Design Condition

- 2012 hydrology and climate
  - With shipping channel dredged
  - Benthic/SOD fluxes and kinetics remain same
- Boundary flows based on estimate of actual flows for 2012
  - Difference between actual and permitted flow capacity will not affect hydrodynamics
- Point source concentrations
  - Direct impacts
    - Ammonia
    - Dissolved oxygen saturation
    - CBOD
    - Nitrate
  - Indirect impacts – other parameters
  - 50th percentile of seasonal values from intensive monitoring period (2018-2019)

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Analysis of Attainability Methodology under development

Future Scenario Ideas

- Four levels of point source reductions
  - NH3 = 10, 5, 1.5 mg/L → adjust NO3 accordingly
  - TN = 4 mg/L
  - Applied to: Tier 1 only, Tier 1 + 2, all
    - Individual WWTP sensitivity
  - DO = 90% and 100% saturation
- Source sensitivity (-10%, -25%, -50%)
  - Reduce carbon and nitrogen loads
  - Applied to: tributaries/MS4, CSOs, WWTPs

Metrics to Compare Scenarios

- Define critical propagation period as May 1 to October 15
  - Overlap of spawning/growth/development with period of low DO events
- Spatial graphs of X percentile DO
  - Define bins within Zones as needed to capture critical areas
- Spatial graphs of DO Stress Index
  - Indicator = (mg/L × hrs) below a threshold
    - e.g., 5.0 mg/L

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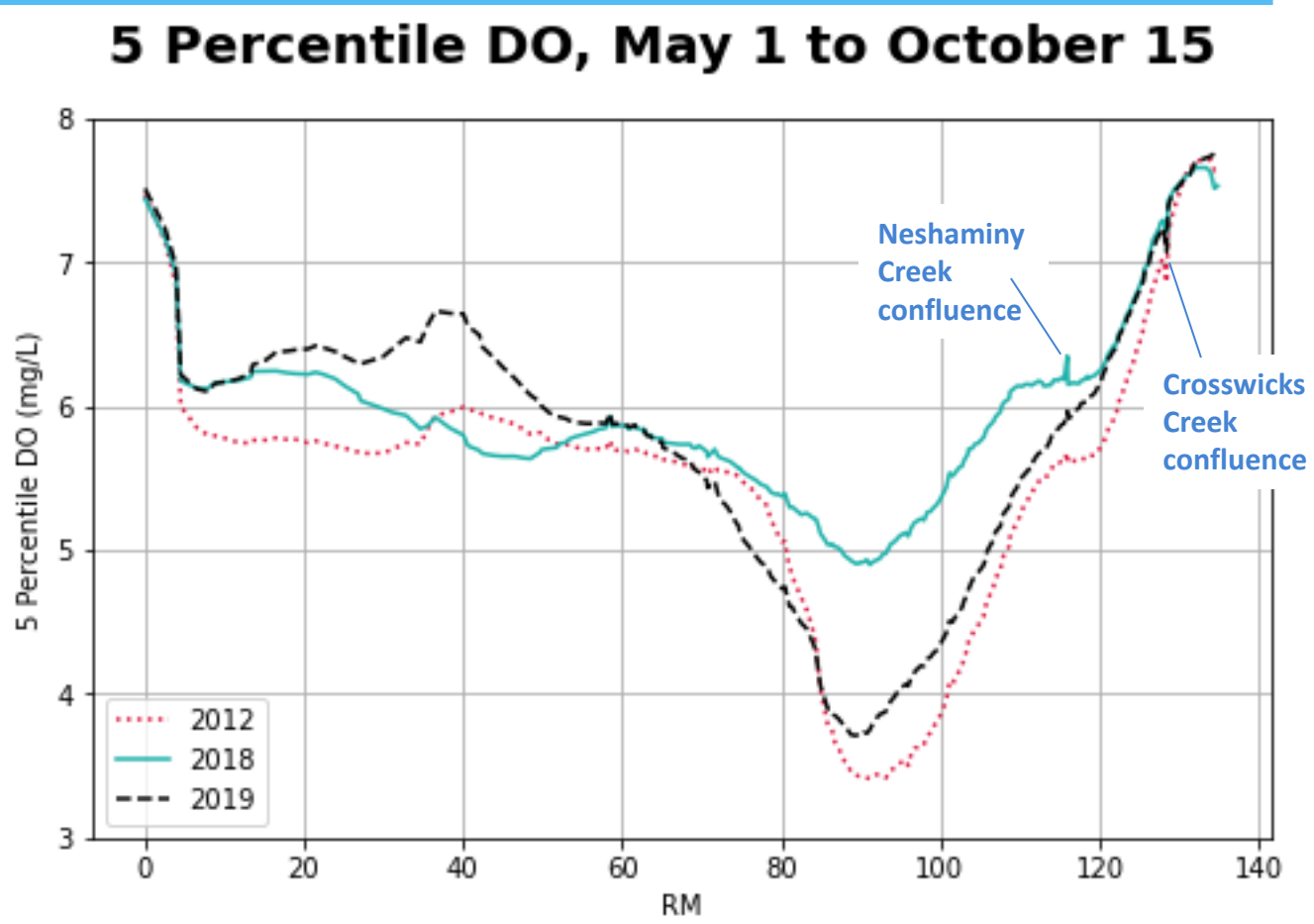
Spatial Low DO Metric

METHODOLOGY

1. Extract DO time series data during critical propagation season (May 1–Oct 15) from every cell in the mainstem.
2. For each transect (a 1-cell-thick "slice" at a particular RM), combine DO records from every cell.
3. Take Xth percentile value from that combined dataset and plot by RM.



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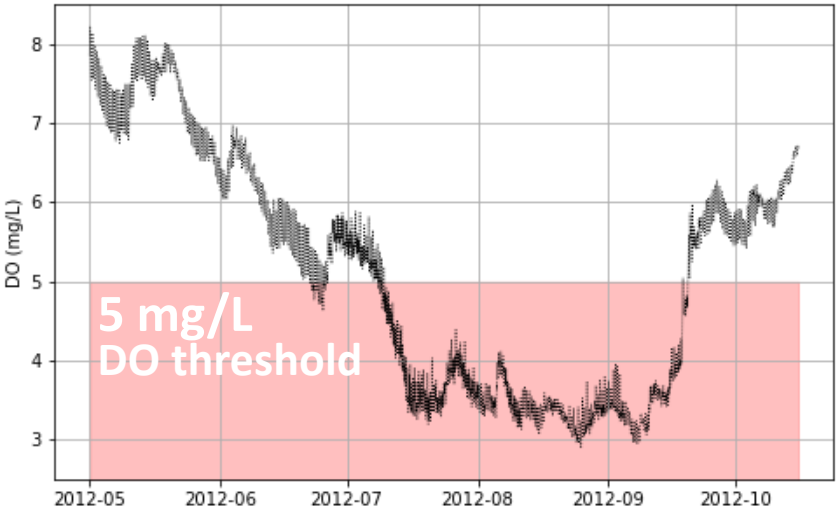
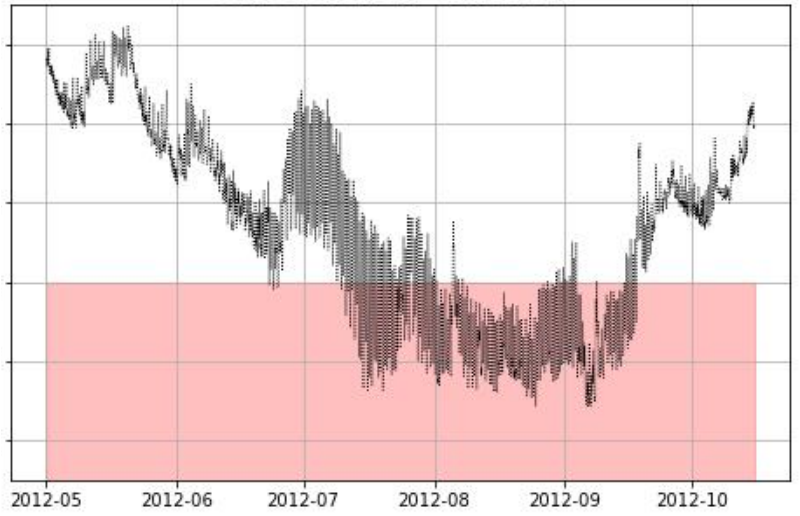
DO STRESS INDEX

How to quantify frequency, magnitude and duration of low dissolved oxygen events

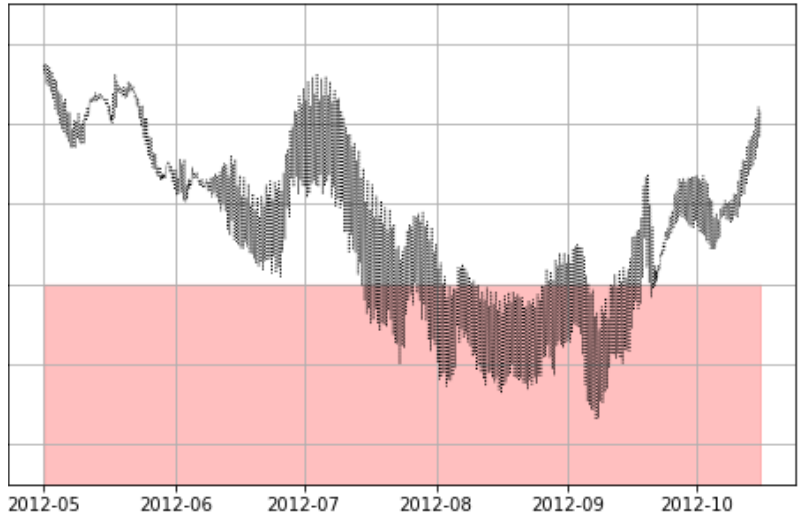
A. >2 months at ~1.5 mg/L below



B. >2 months at ~0.75 mg/L below



C. ~1.5 months at ~0.75 mg/L below



A vs. B: Similar duration below the threshold, but A represents more “stress” (lower DO levels)

B vs. C: Similar DO levels, but B represents more “stress” (longer duration at low DO)

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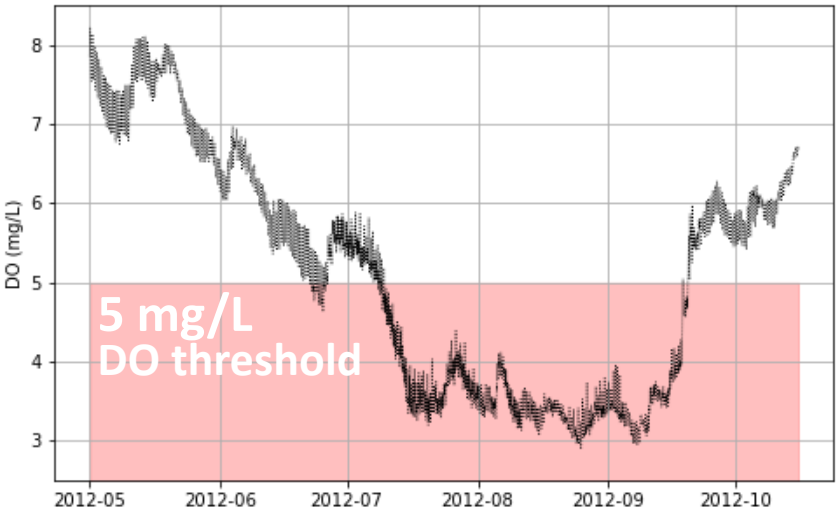

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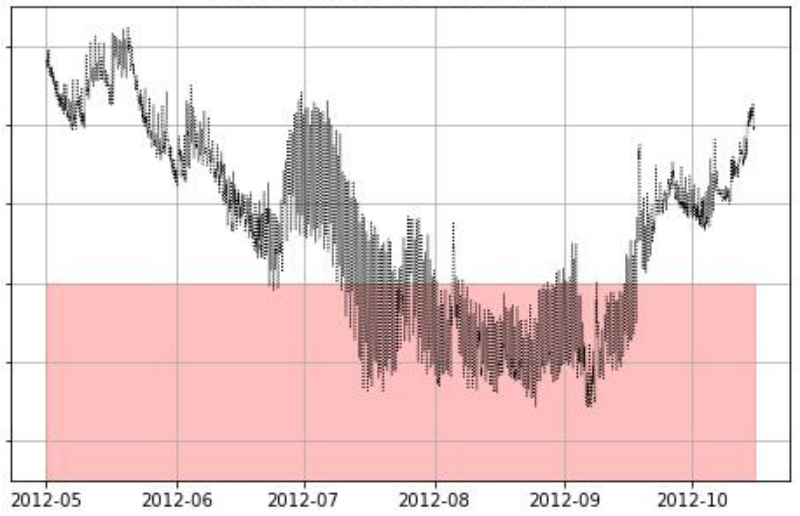

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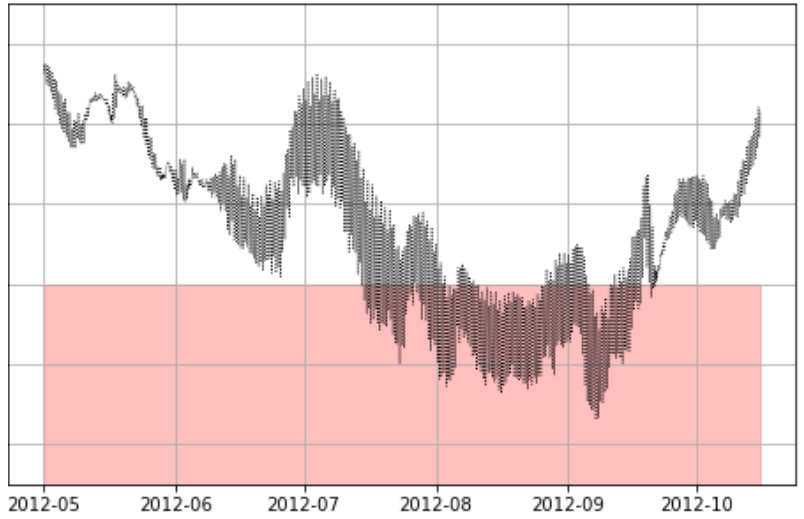


A vs. B: Similar duration below the threshold, but A represents more "stress" (lower DO levels)

B vs. C: Similar DO levels, but B represents more "stress" (longer duration at low DO)

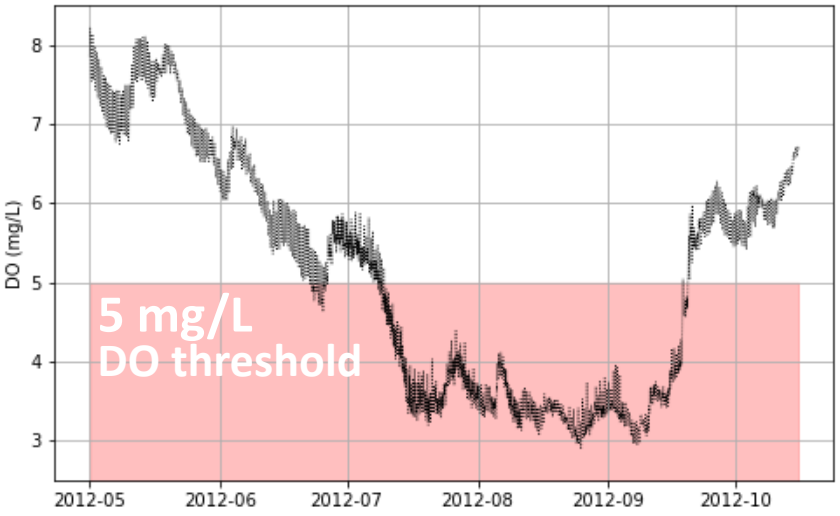
DO stress index = How far below the threshold is DO? x How long is it below the threshold?

- **1 stress "unit" = 1 mg/L below DO threshold for 4 hours**
- Stress index of 50 indicates that this happened 50 times over the course of a season

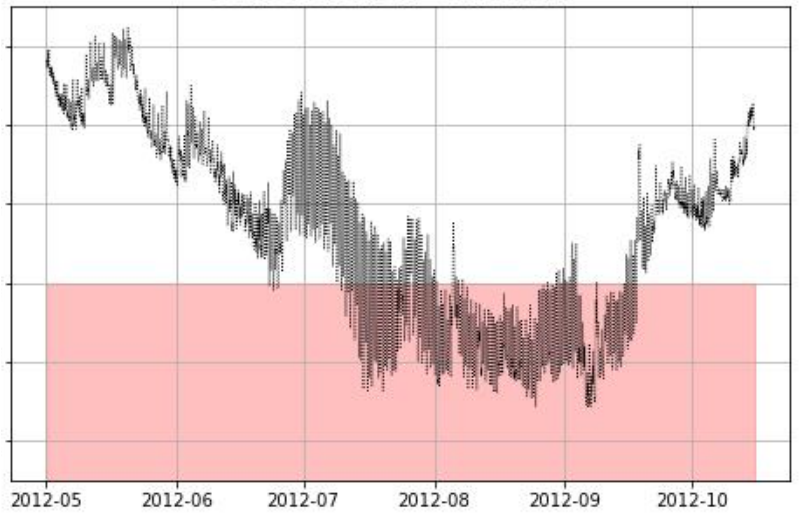
DO STRESS INDEX

How to quantify frequency, magnitude and duration of low dissolved oxygen events

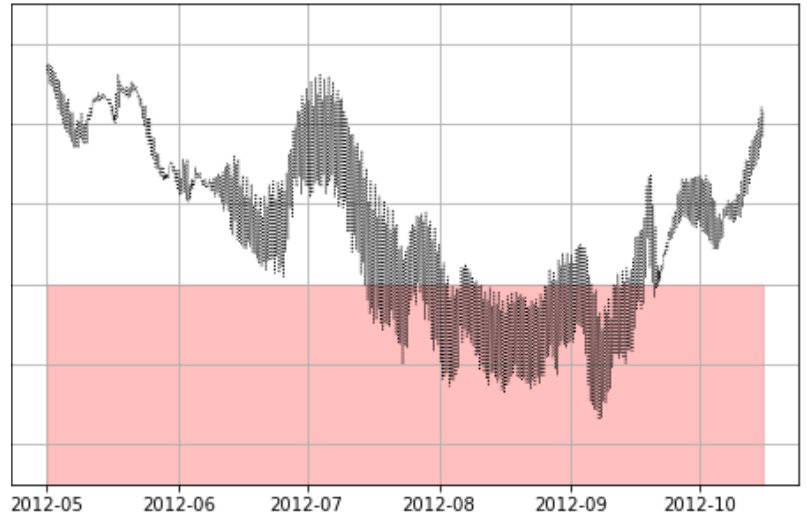
A. Stress index = 619



B. Stress index = 278



C. Stress index = 150



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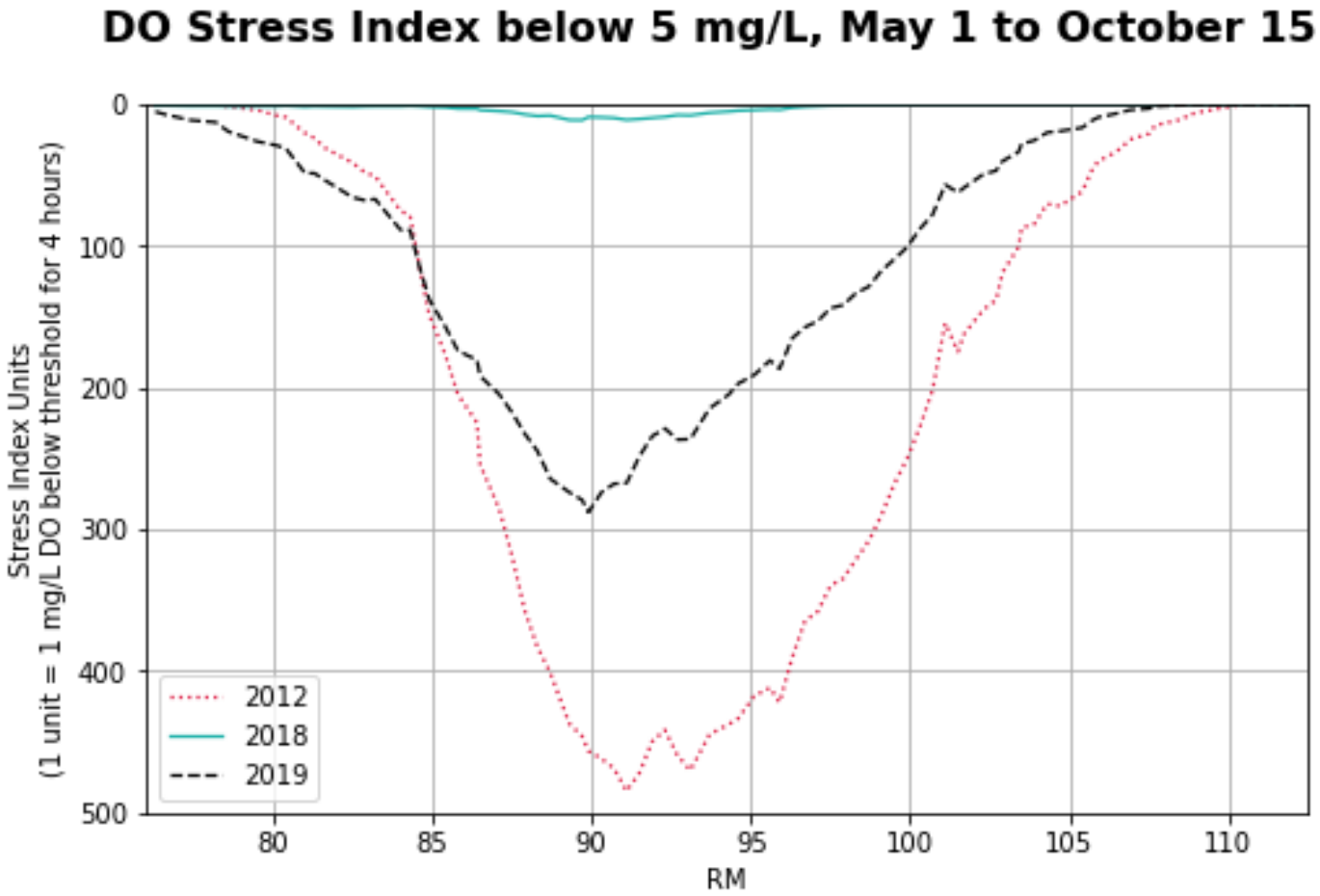
Using this stress index, A > B > C

DO Stress Index Methodology

1. Extract DO time series data during critical propagation season (May 1–Oct 15) from every cell in the mainstem.
2. For each cell, compute stress index:
   - Subtract threshold DO value (5 mg/L) from the time series record
   - Zero out any positive values (any value that was originally above the threshold)
   - Calculate the area under the curve
     - units = mg/L × hours
   - Divide by –4 (more stress = bad)
     - 1 “unit” = 1 mg/L below threshold for 4 hours
3. Calculate the median stress index among the cells in every “slice”.



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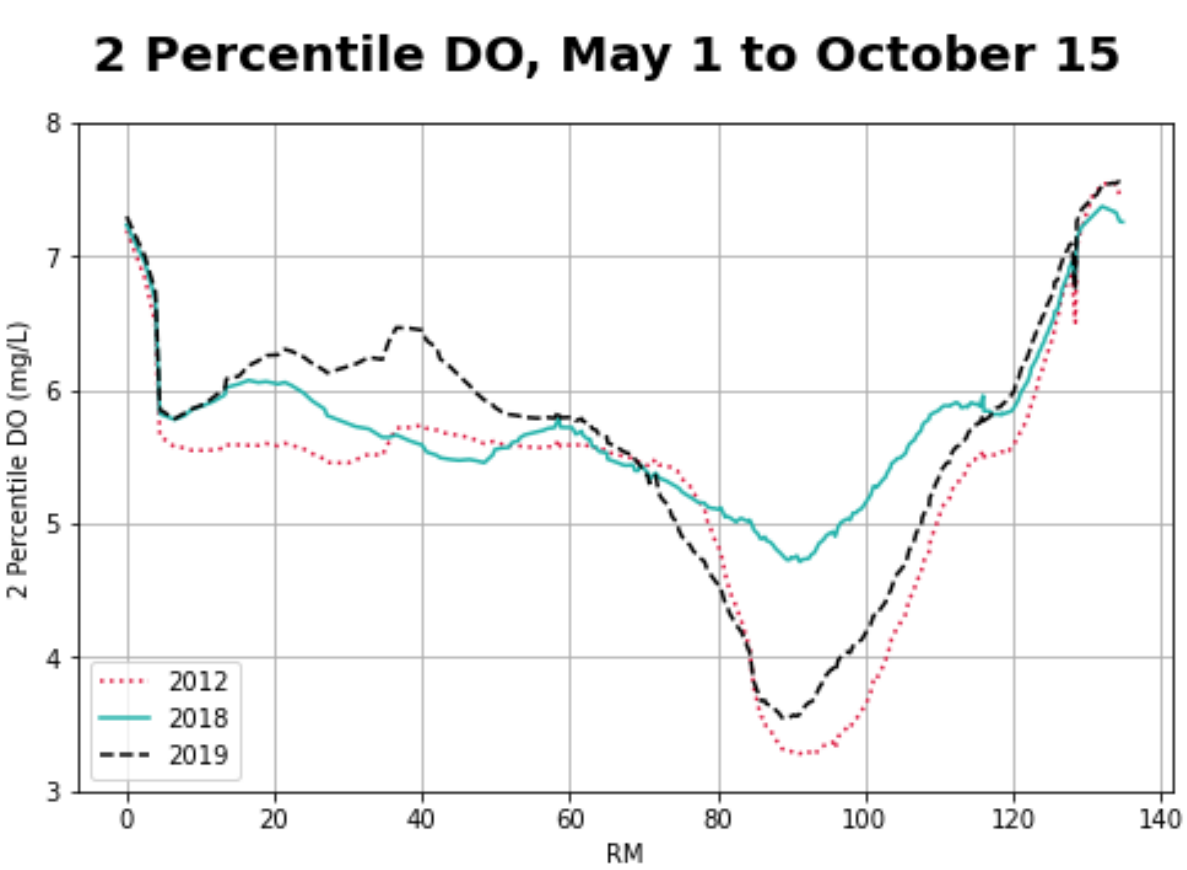

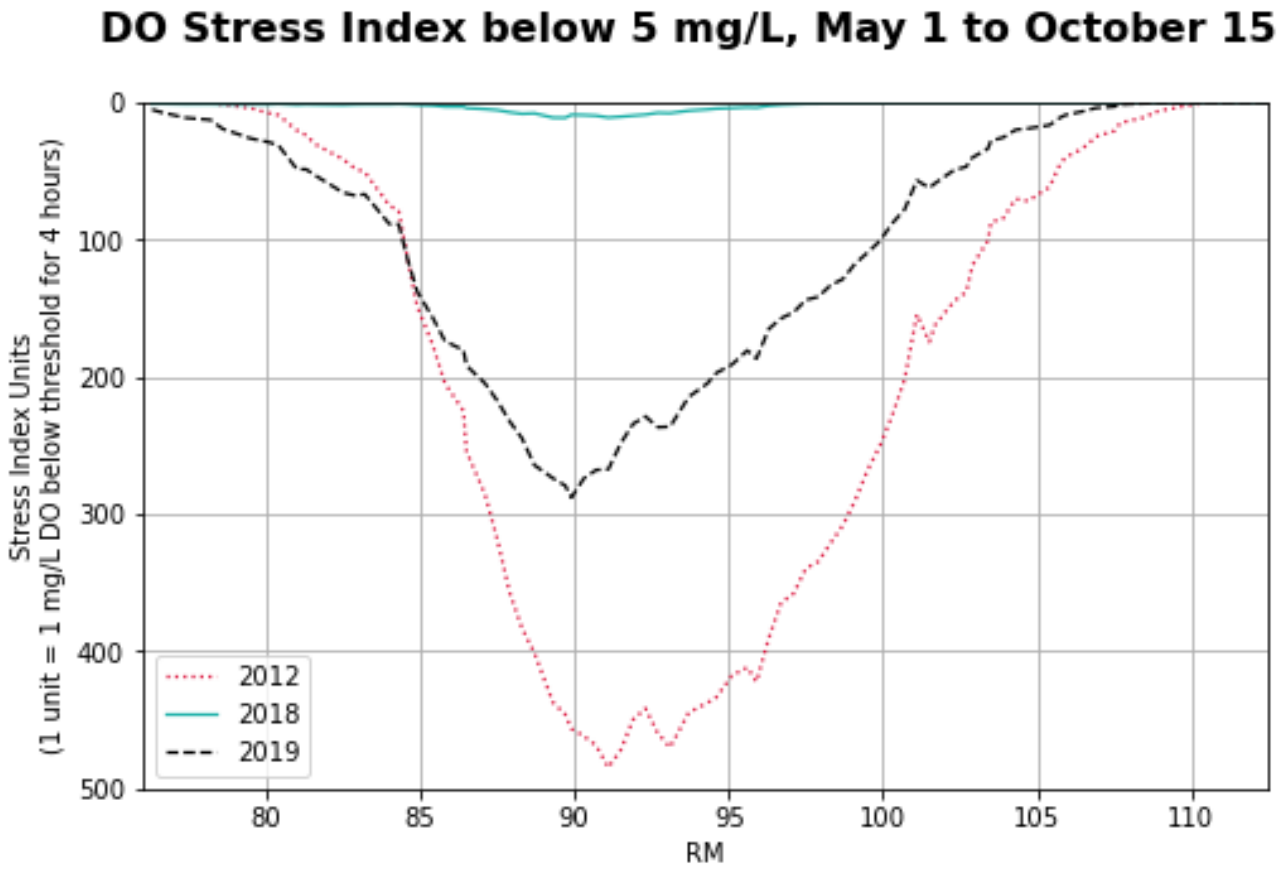

Comparing two DO indicators

DO Stress Index amplifies differences between years within the DO sag (RM ~88–95)

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Discussion

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