Dissolved Oxygen Criteria Attainment at "Continuous Monitoring" Buoys in Potomac Tidal Shallow Waters

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DO Umbrella Criteria Workshop

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2009 Potomac Embayment Study

Continuous monitoring (CMON) data

- Maryland and Virginia Potomac data
- 2004 - 2008 (1-5 years)
- 20 *shallow water* sites
  - n = 57 sites*years
- Chl *a*, pH, dissolved oxygen, turbidity
- 15 min intervals, from spring to summer/autumn
  - > 1 million DO measurements

DO Umbrella Criteria Analysis

30-day Mean DO

- 5.5 mg/l . . . . . year-round TF & OH
- 5 mg/l . . . . . .year-round MH

7-day Mean DO

- 6 mg/l . . . . . .Feb 1 - May 31 TF & OH
- 4 mg/l . . . . . .Jun 1 - Jan 31 all salinities
  Feb 1 - May 31 MH

Instantaneous Minimum DO

- 5 mg/l . . . . . .Feb 1 - May 31, TF & OH
- 3.2 mg/l @ $<29^{o}C$, 4.3 mg/l @ $\geq 29^{o}C$
  Jun 1 - Jan 31 all salinities
  Feb 1 - May 31 MH

Calculations

30-Day Mean DO

- mean of all CMON DO measurements in a 30-day period *(~2,880 measurements/month)*
- mean of all point sample DO measurements in a 30-day period *(typically1-2 visits/month)*

7-Day Mean DO

- mean of all CMON DO measurements in a 7 day period beginning at midnight on the first day *(~672 measurements/7-day period)*

Instantaneous Minimum DO

- proportion of CMON DO measurements failing the instantaneous minimum criteria in the same 7- or 30-day period

Potomac Estuary Shallow Waters

Is the

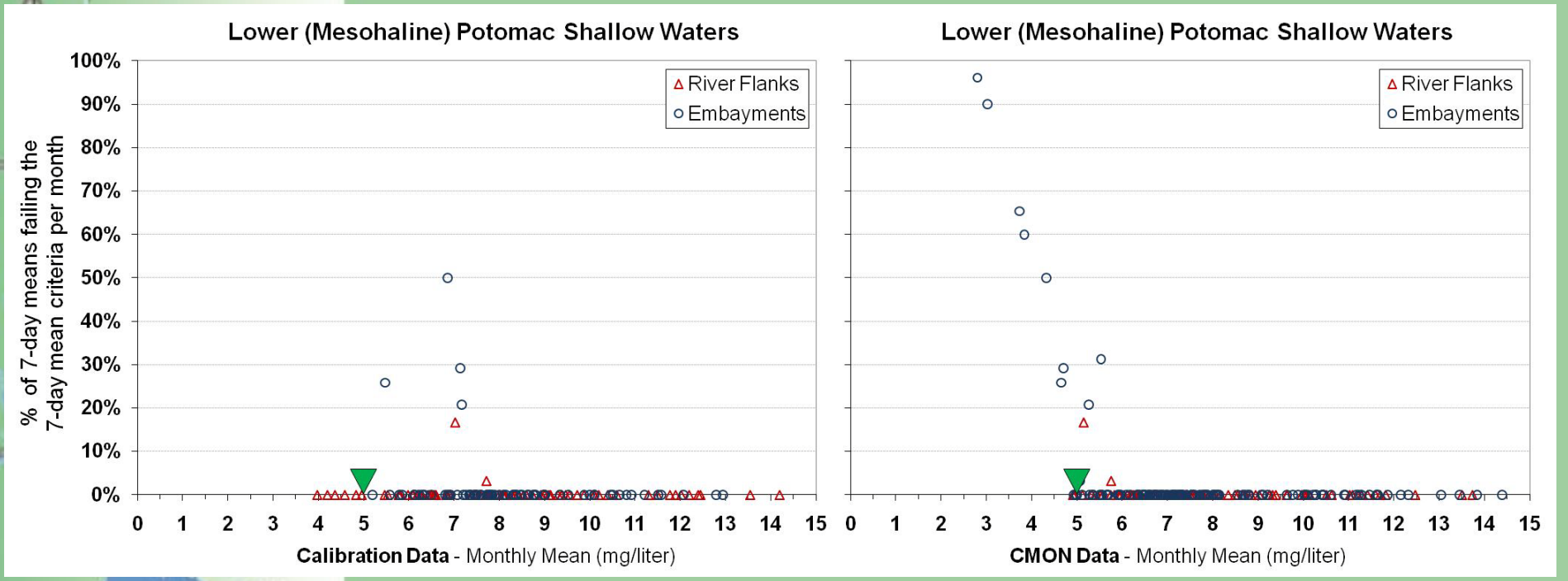
30-day mean DO criteria

protective of the

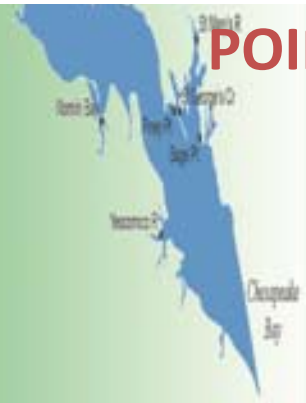
7-day mean DO criteria?

(Mesohaline examples)

%Failing 7-Day Mean Criteria *vs* Monthly Mean



POINT SAMPLE DATA **CMON DATA, 1-day step**



Depending on allowable exceedances, the 30-Day Mean Criteria *could be* protective of the 7-Day Mean Criteria (Spring, Summer & Autumn)

Relationships “cleaner” with CMON data

Potomac Estuary Shallow Waters

Is the

30-day mean DO criteria

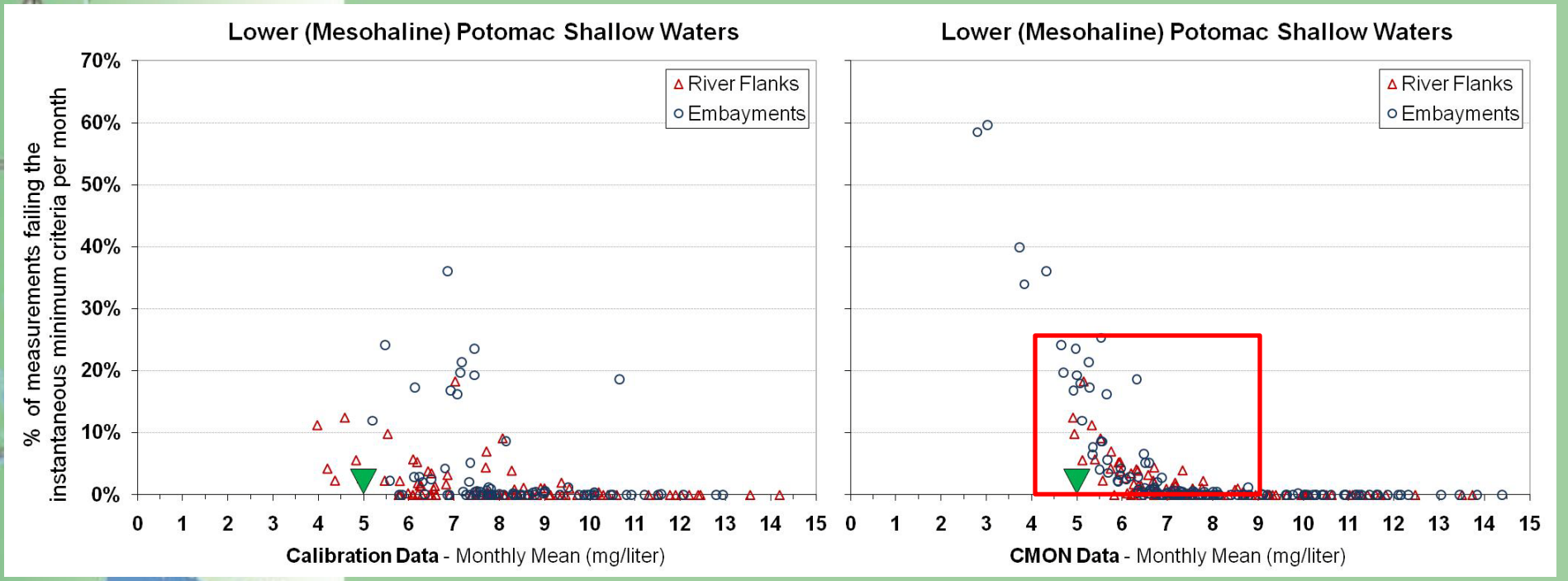
protective of the

instantaneous minimum

DO criteria?

(Mesohaline examples)

%Failing Inst. Min. Criteria *vs* Monthly Mean

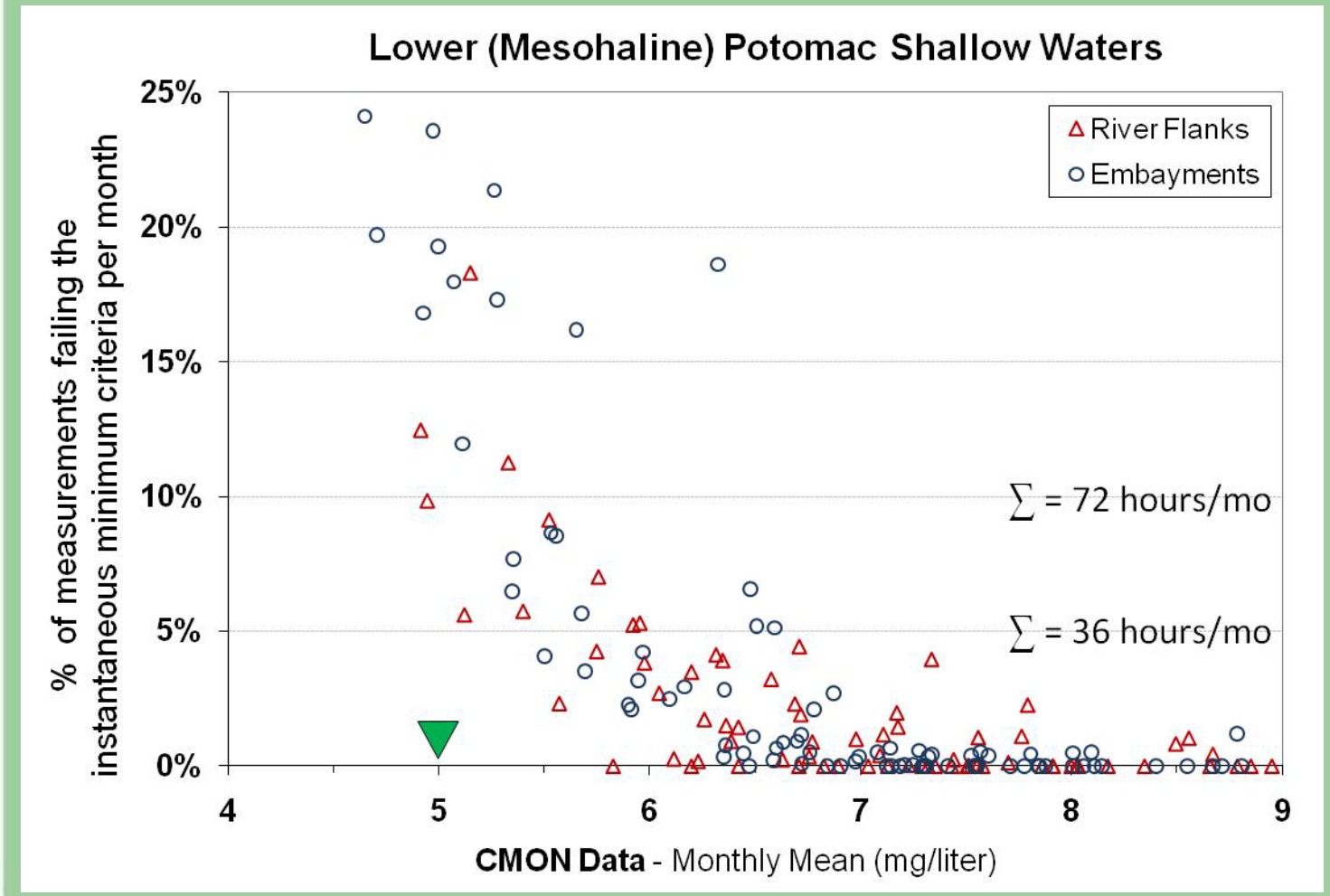


POINT SAMPLE DATA **CMON DATA**

Assuming no allowable exceedances, the 30-Day Mean Criteria ***is not*** protective of the Instantaneous Minimum Criteria (Spring, Summer & Autumn)

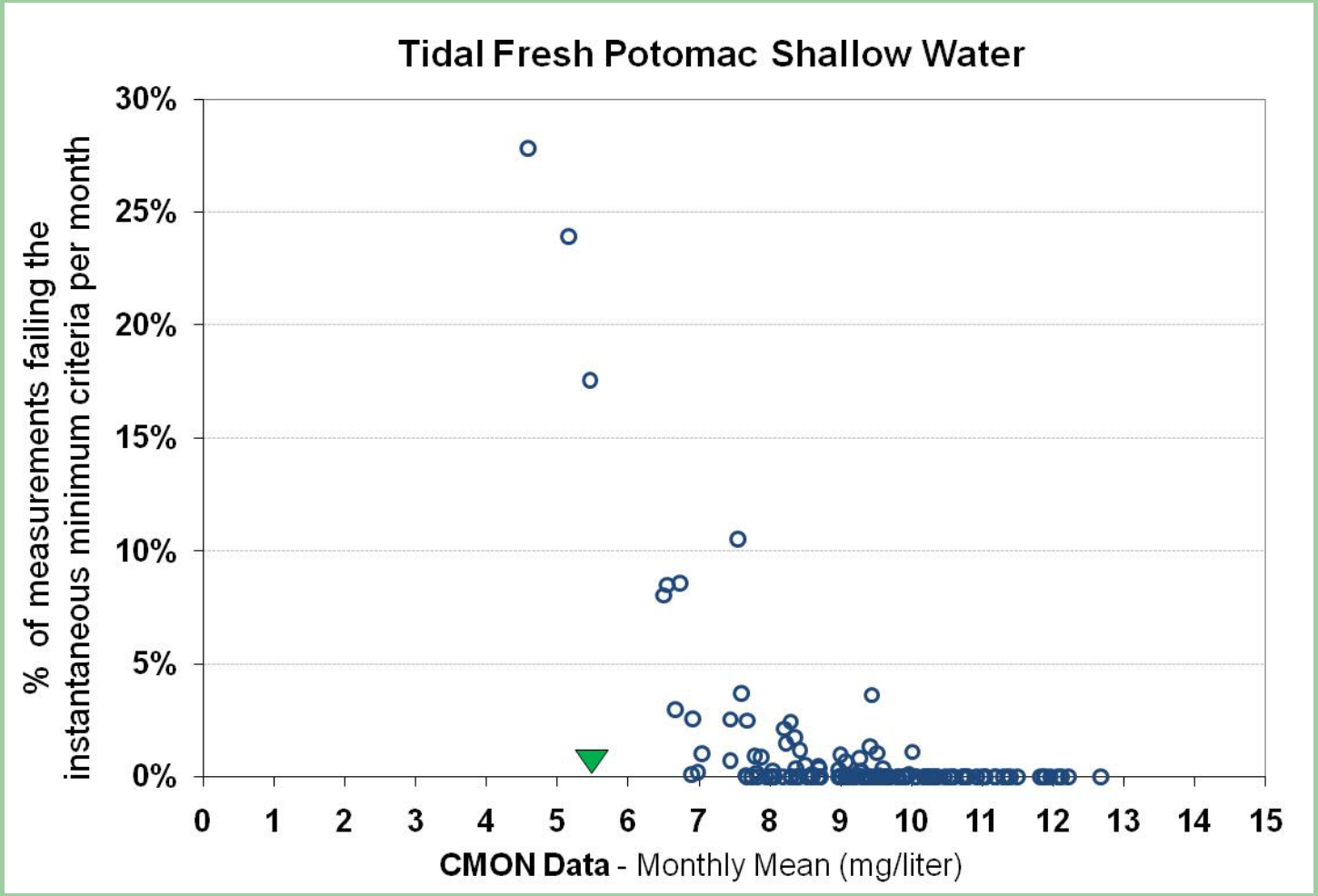
Relationships “cleaner” with CMON data

%Failing Inst. Min. Criteria *vs* Monthly Mean



At monthly mean DO = 6 mg/l, nearly all months have some failure of the instantaneous minimum criteria.

%Failing Inst. Min. Criteria *vs* Monthly Mean



At monthly mean DO = 7 mg/l, nearly all months have some failure of the instantaneous minimum criteria.

Potomac Estuary Shallow Waters

Is the

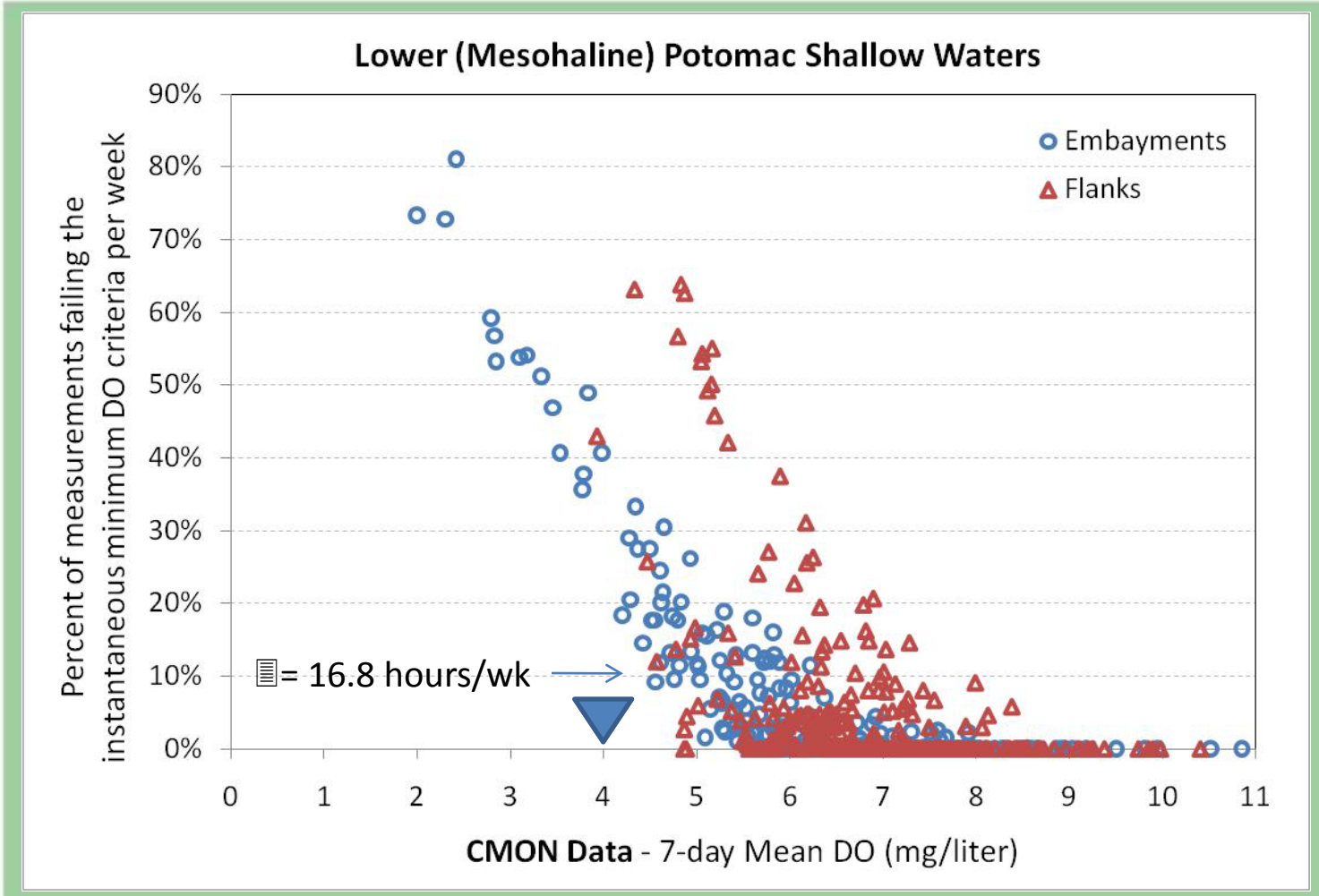
7-day mean DO criteria

protective of the

instantaneous minimum

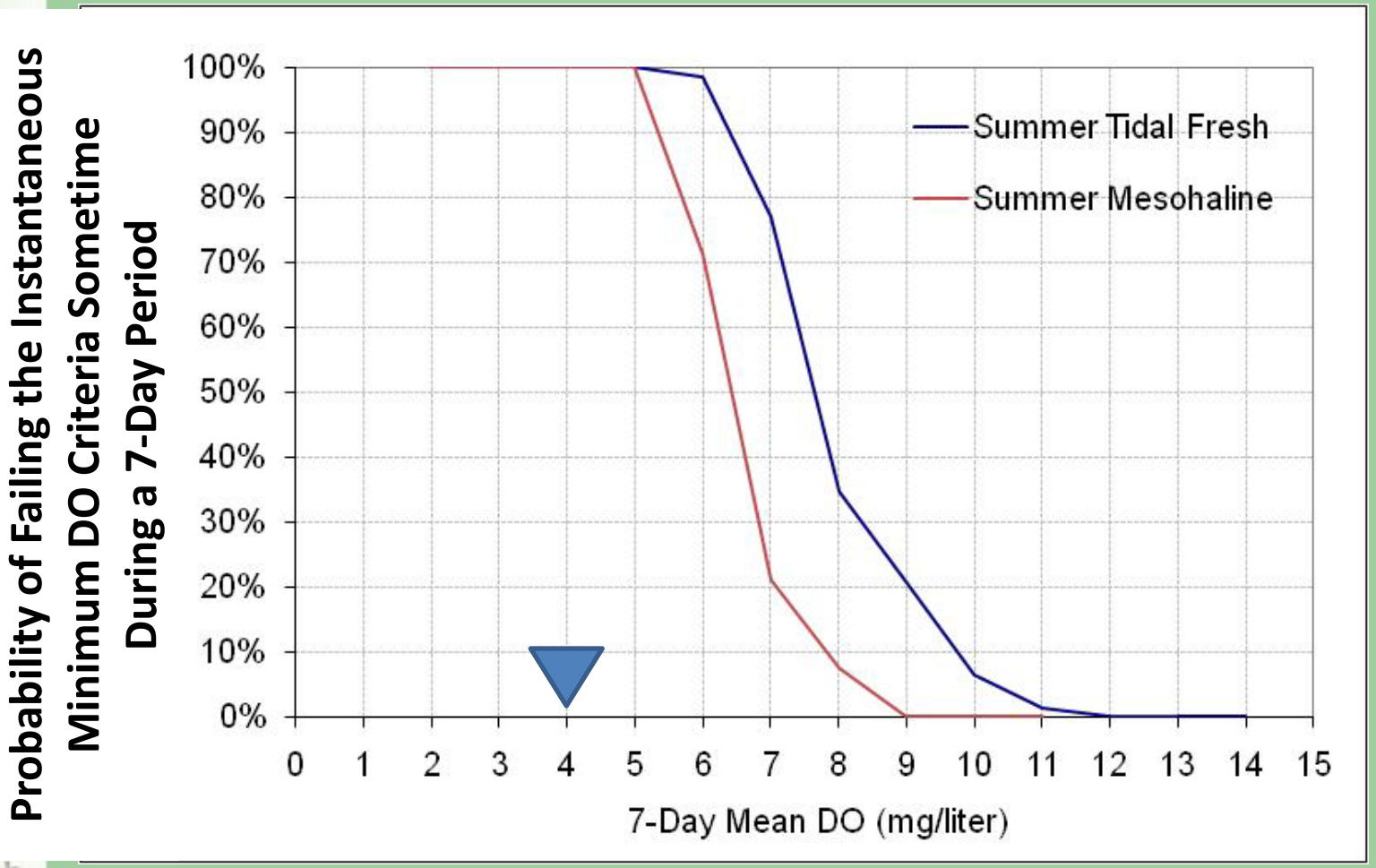
DO criteria?

%Failing Inst. Min. Criteria *vs* 7-Day Mean



Assuming there are no allowable exceedances, the 7-Day Mean Criteria ***is not*** protective of the Instantaneous Minimum Criteria (Spring, Summer & Autumn)

%Failing Inst. Min. Criteria *vs* 7-Day Mean



Potomac Estuary Shallow Waters

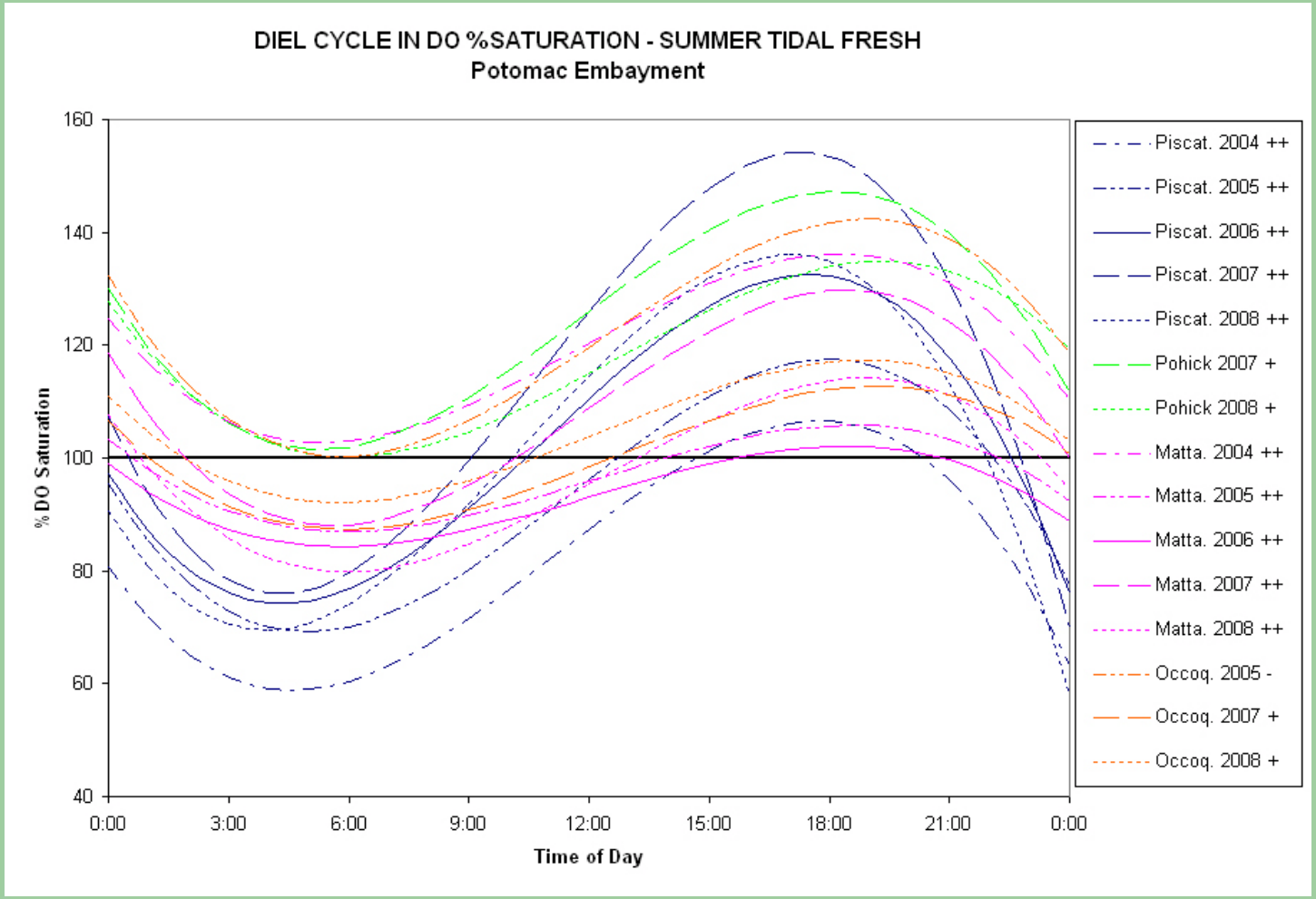
Shallow water DO criteria failure rates (all seasons, all salinities, all stations)

- 30-day mean DO: 4.30%
- 7-day mean DO: 1.89%
- Instantaneous minimum DO: 2.33% (**24,246** of 1,042,700 measurements)

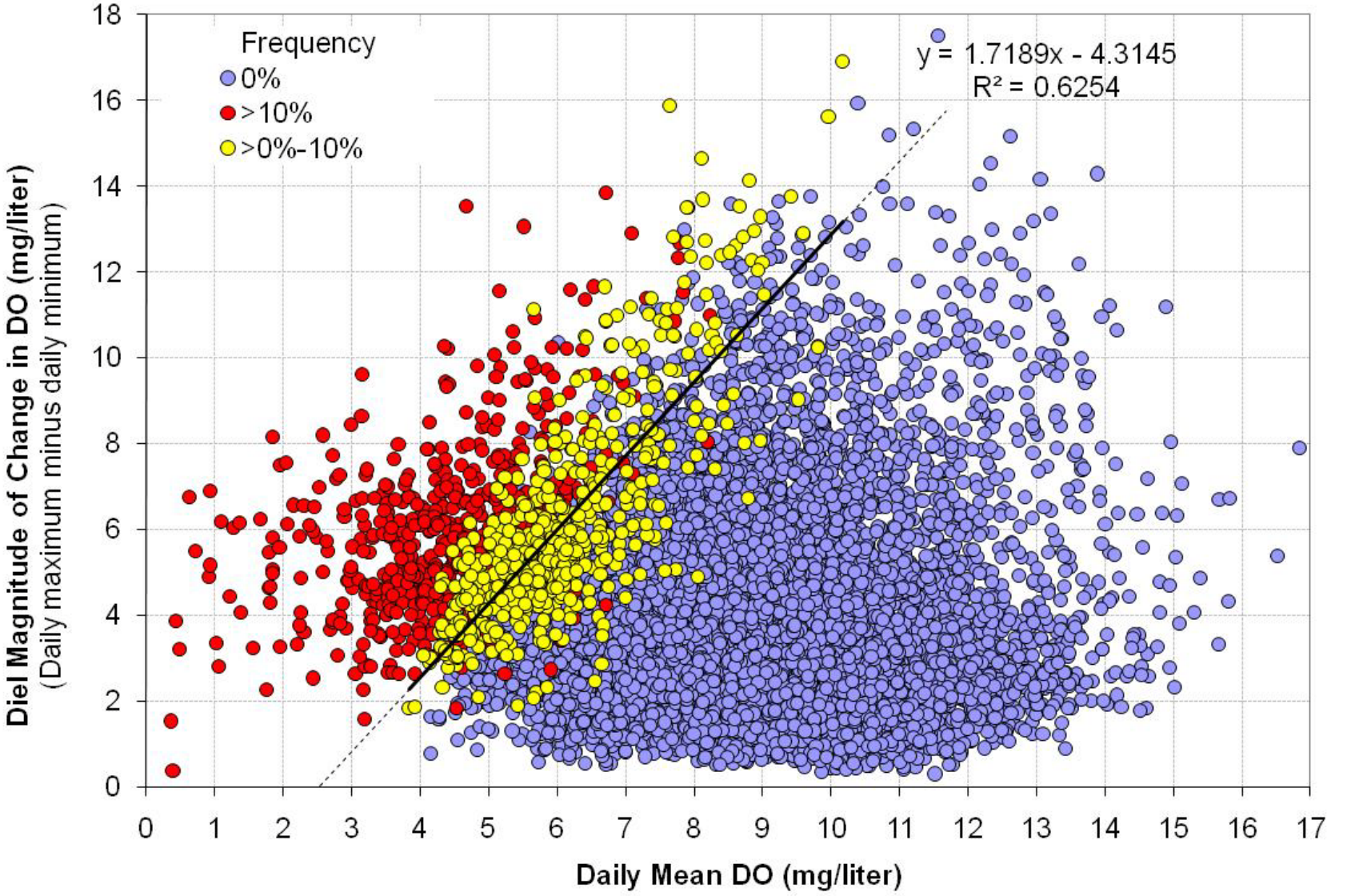
Why are Potomac shallow waters so susceptible to DO criteria failures?

Diel Magnitude of Change in DO

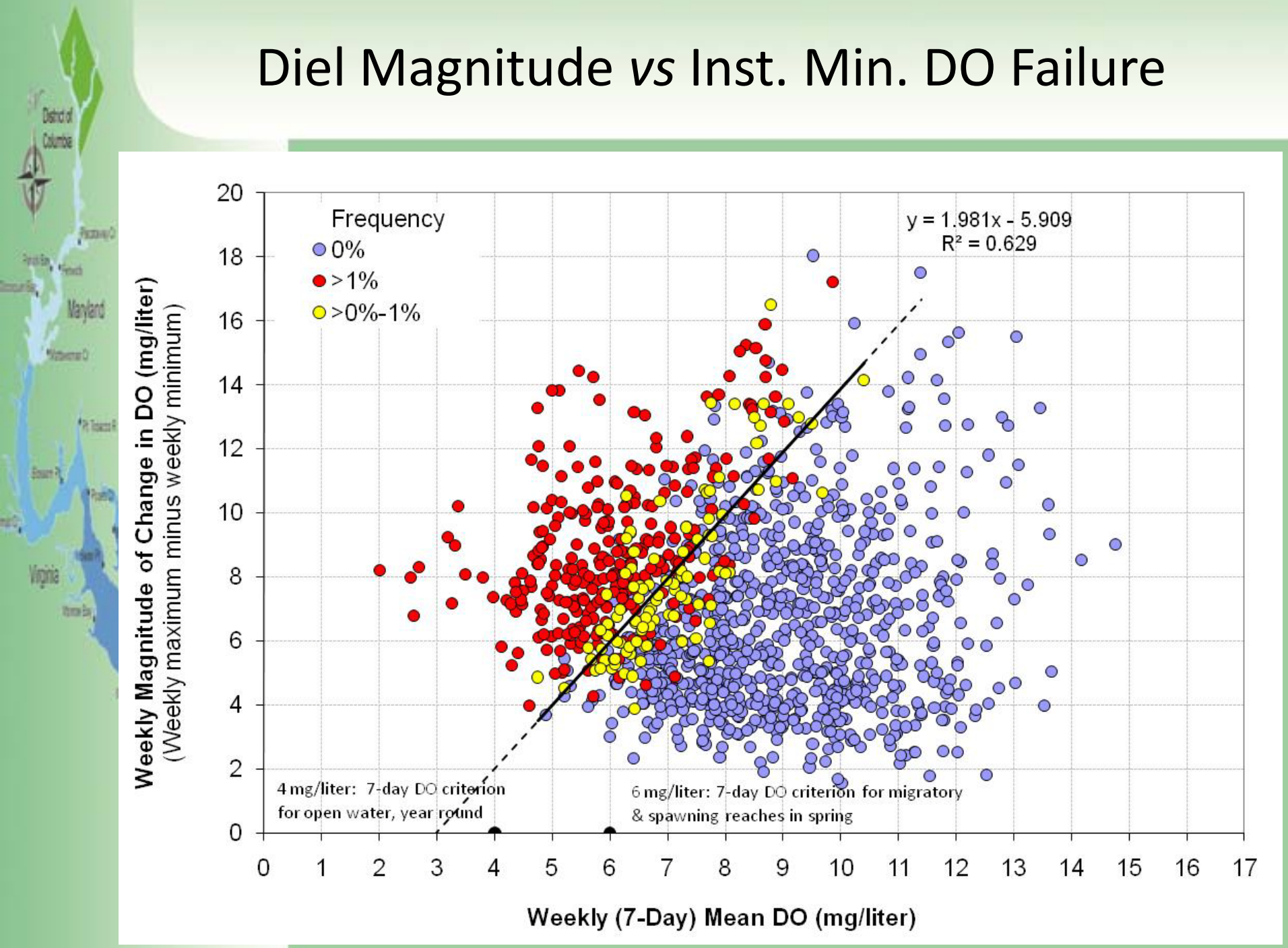
Proximity to bottom + three plant communities = large diel (daily) magnitude of change in DO



Diel Magnitude *vs* Inst. Min. DO Failure

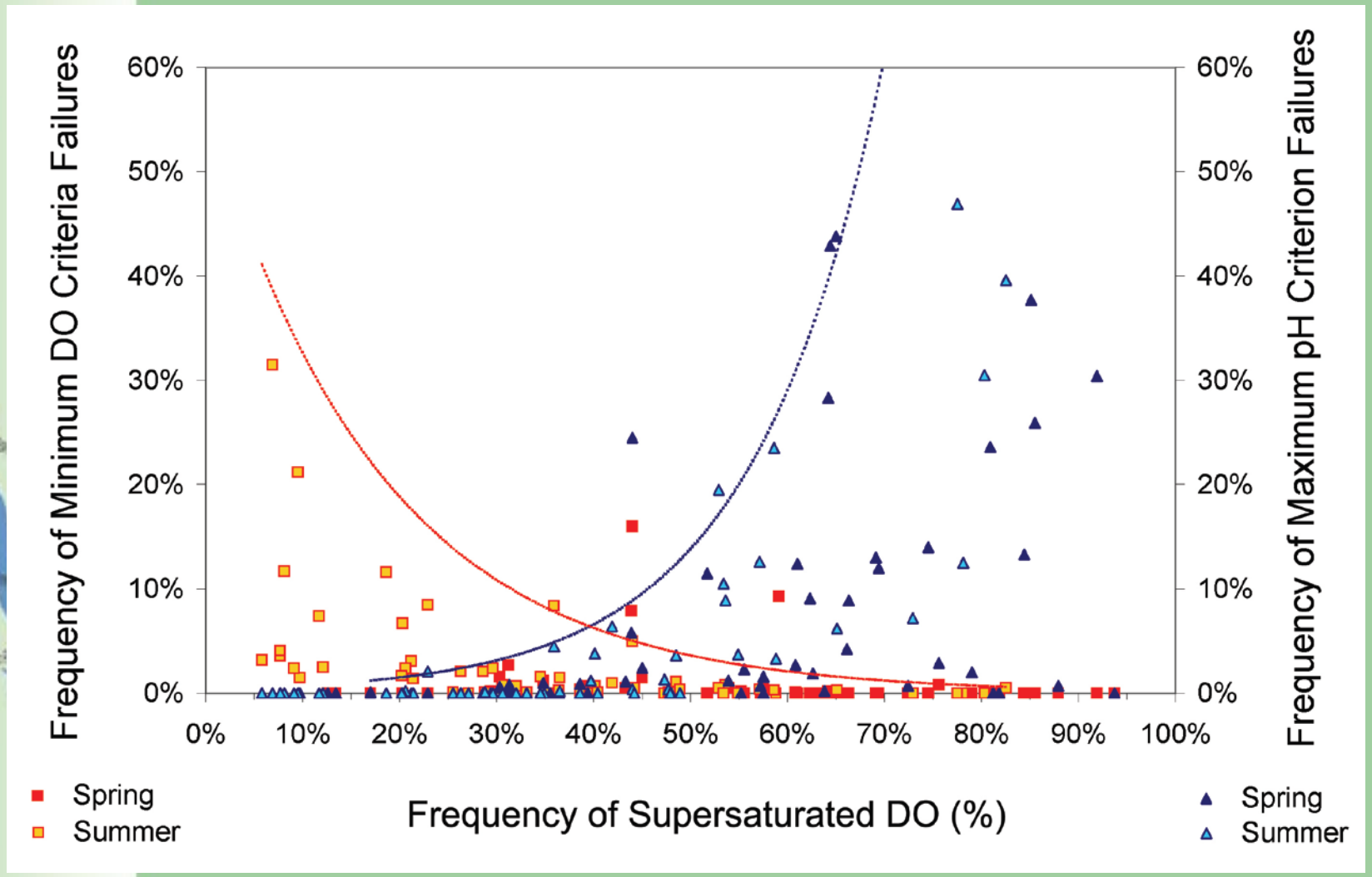


Diel Magnitude *vs* Inst. Min. DO Failure



Diel Magnitude of Change in pH

Large *increases* in DO => large *decreases* in CO_2 => pH criteria failures



Shallow waters have different & more sources and sinks of dissolved oxygen than Open Waters. Shallow Water Designated Use Areas should have their own DO Criteria.

MD and VA Shallow Water Monitoring Data

MD: http://mddnr.chesapeakebay.net/newmontech/contmon/index.cfm

VA: http://www2.vims.edu/vecos/

More Information

http://www.potomacriver.org/cms/publicationspdf/ICPRB09-03.pdf

http://www.potomacriver.org/cms/publicationspdf/Buchanan_ERF2009_Poster_panels.pdf