

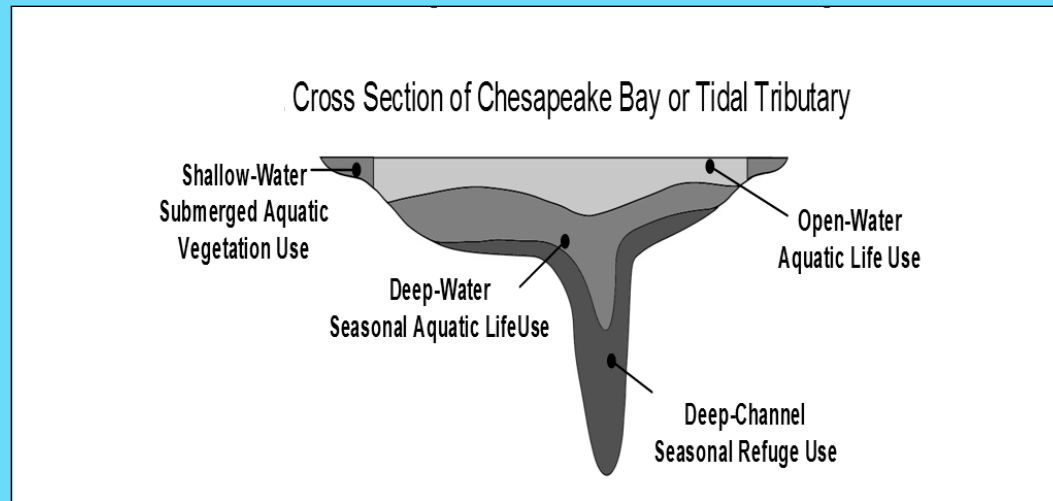
Challenges in Evaluating IM Criteria in Open-Water and Deep-Water using the Existing Framework

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Virginia DEQ

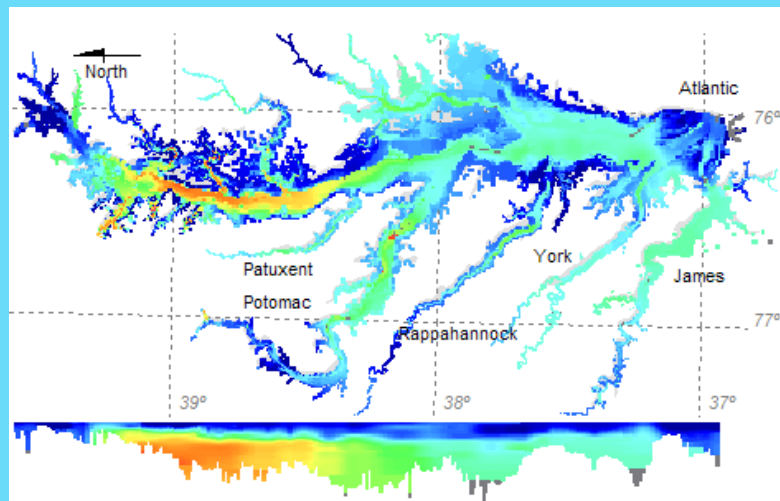
TMAW December 2, 2013

We currently assess the instantaneous minimum (IM), but only for the Deep-Channel Use. The IMs for the Open-Water and Deep-Water Uses have yet to be assessed.



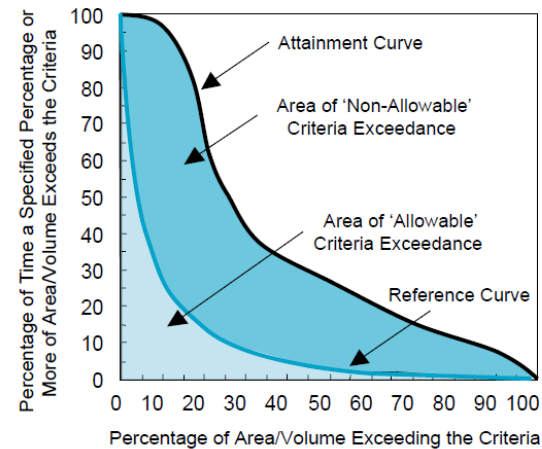
Designated Use	Criteria Assessed	Criteria Awaiting Assessment
Open-Water	30-Day Mean (5.0 mg/l)	7-Day Mean (4.0 mg/l) IM (3.2 or 4.3 mg/l)
Deep-Water	30-Day Mean (3.2 mg/l)	1-Day Mean (2.3 mg/l) IM (1.7 mg/l)
Deep-Channel	IM (1.0 mg/l)	

The Deep-Channel IM and OW/DW 30-Day Mean criteria are assessed using a similar methodology.



Bay Interpolator

+



Cumulative Frequency
Distribution (CFD)

=

305(b)/303(d)
Assessment

If the existing framework is appropriate for the other criteria, including the DC IM, why not use it for the other IMs?

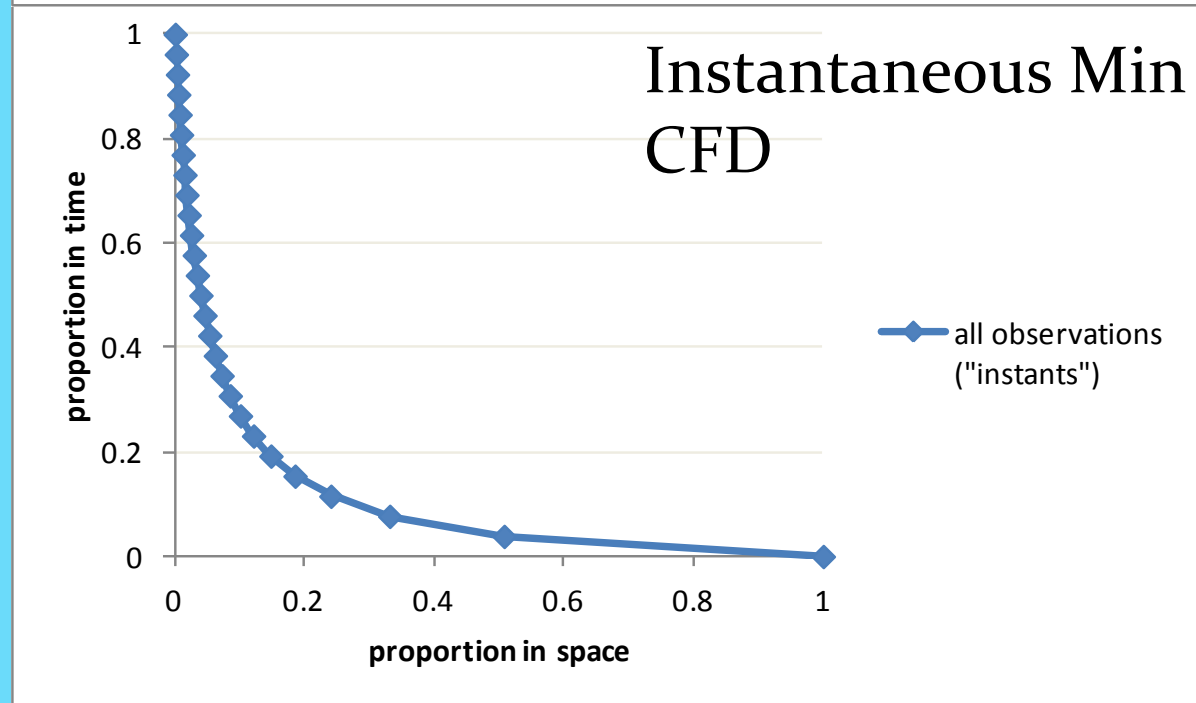
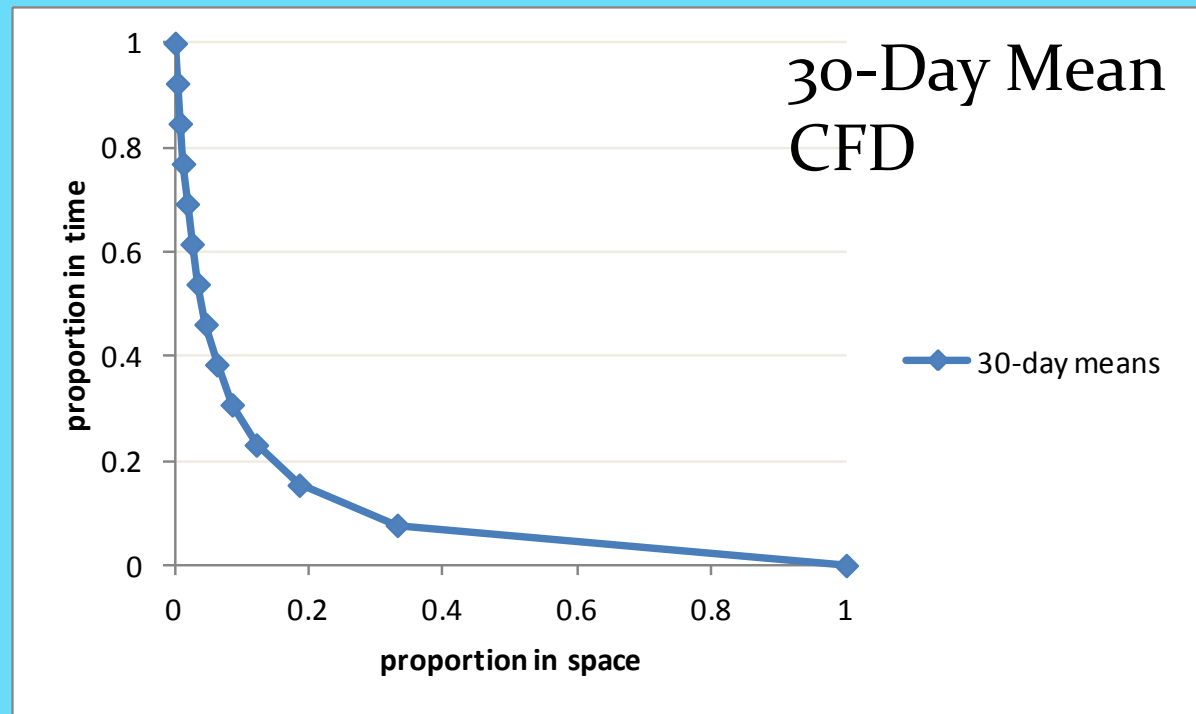
A comparison of methodologies

OW/DC 30-Day Means and DC IM are assessed using:

- Bay Interpolator
- Cumulative Frequency Distribution (CFD)

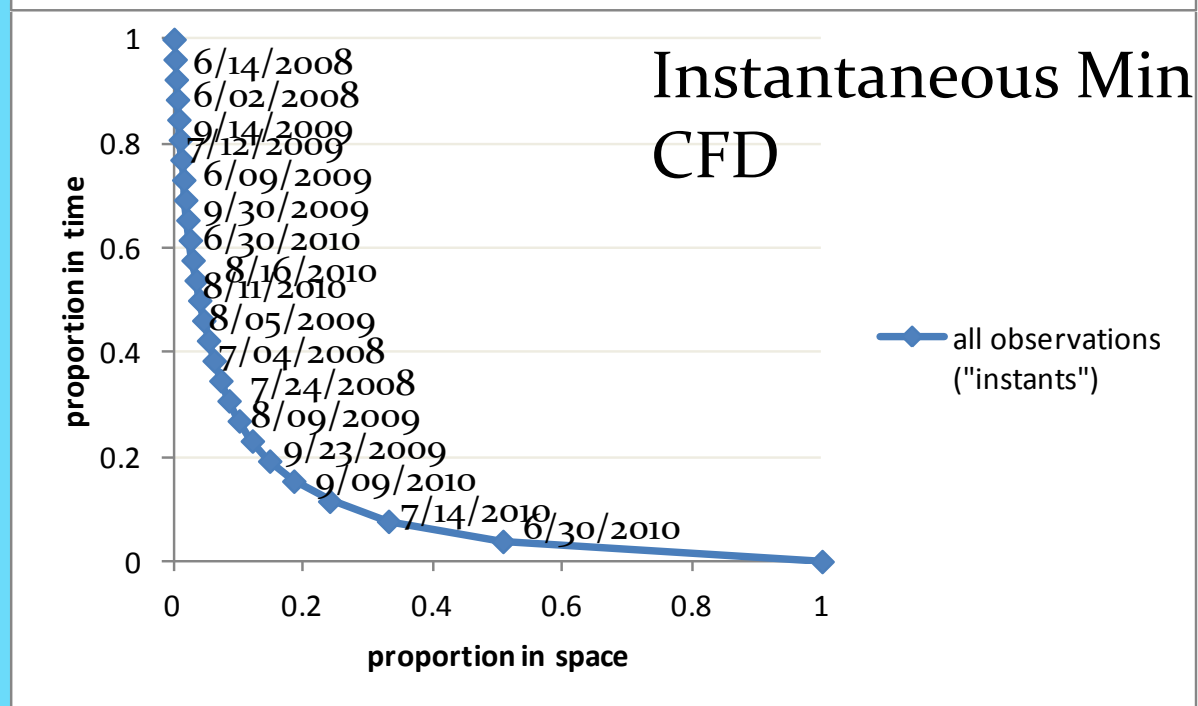
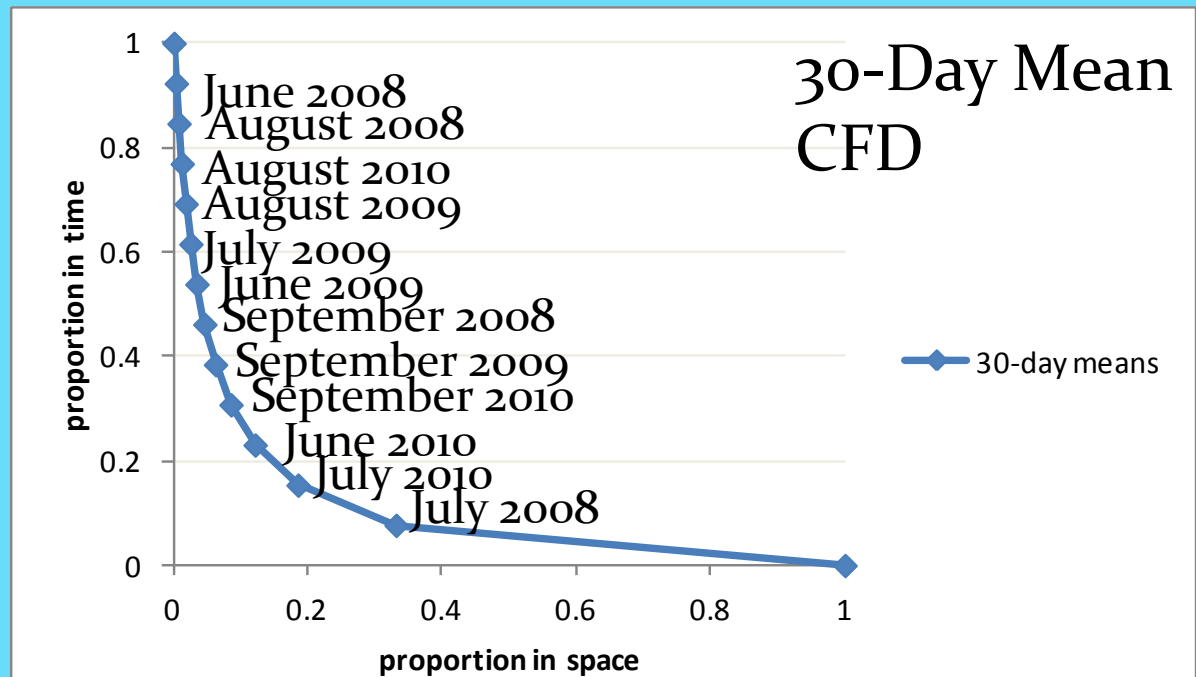
How are they different?

- 30-day Mean: Criteria are assessed against monthly averages of spatial interpolations.
- Instantaneous min: Criterion is assessed against spatially interpolated *station observations*.

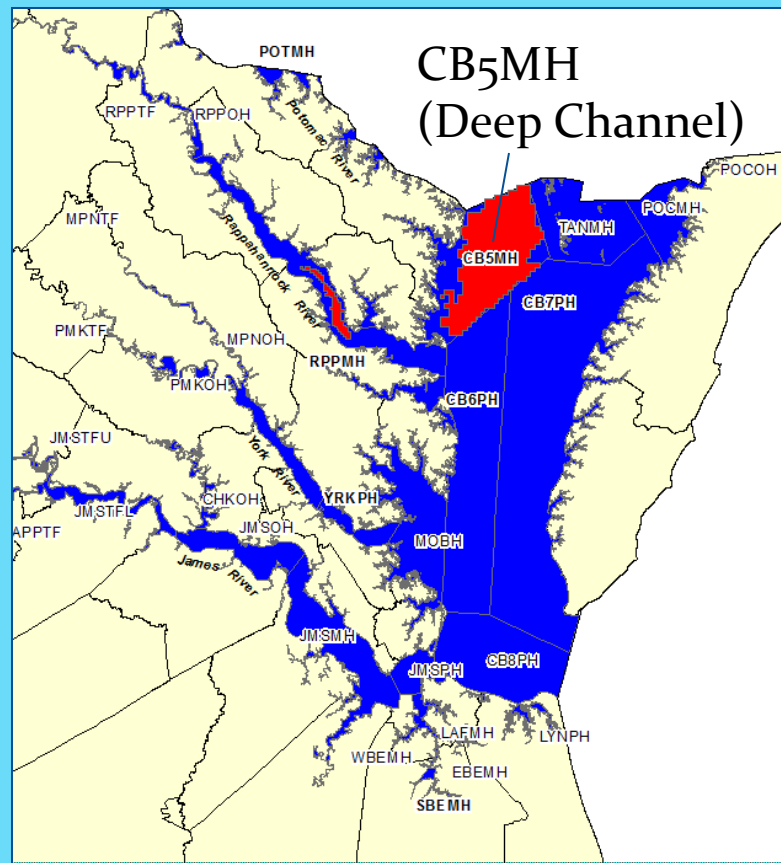


The 30-Day Mean CFD has a maximum number of points ($n = 12$).

The IM CFD is limited only by the number of times a segment is sampled (“instances”) in the three-year assessment window.

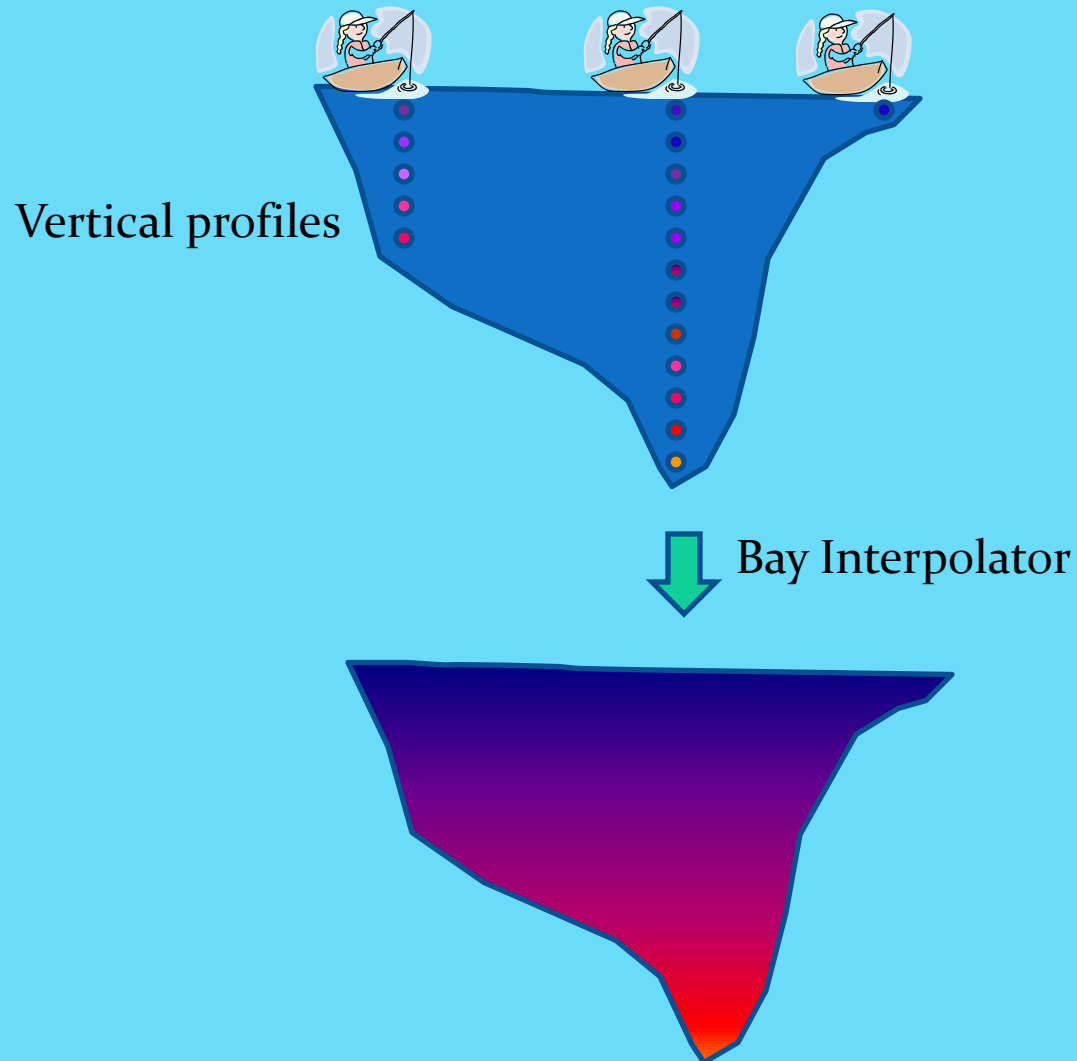


For example, the DC portion of the segment CB5MH is typically observed ~40 times during an assessment period.



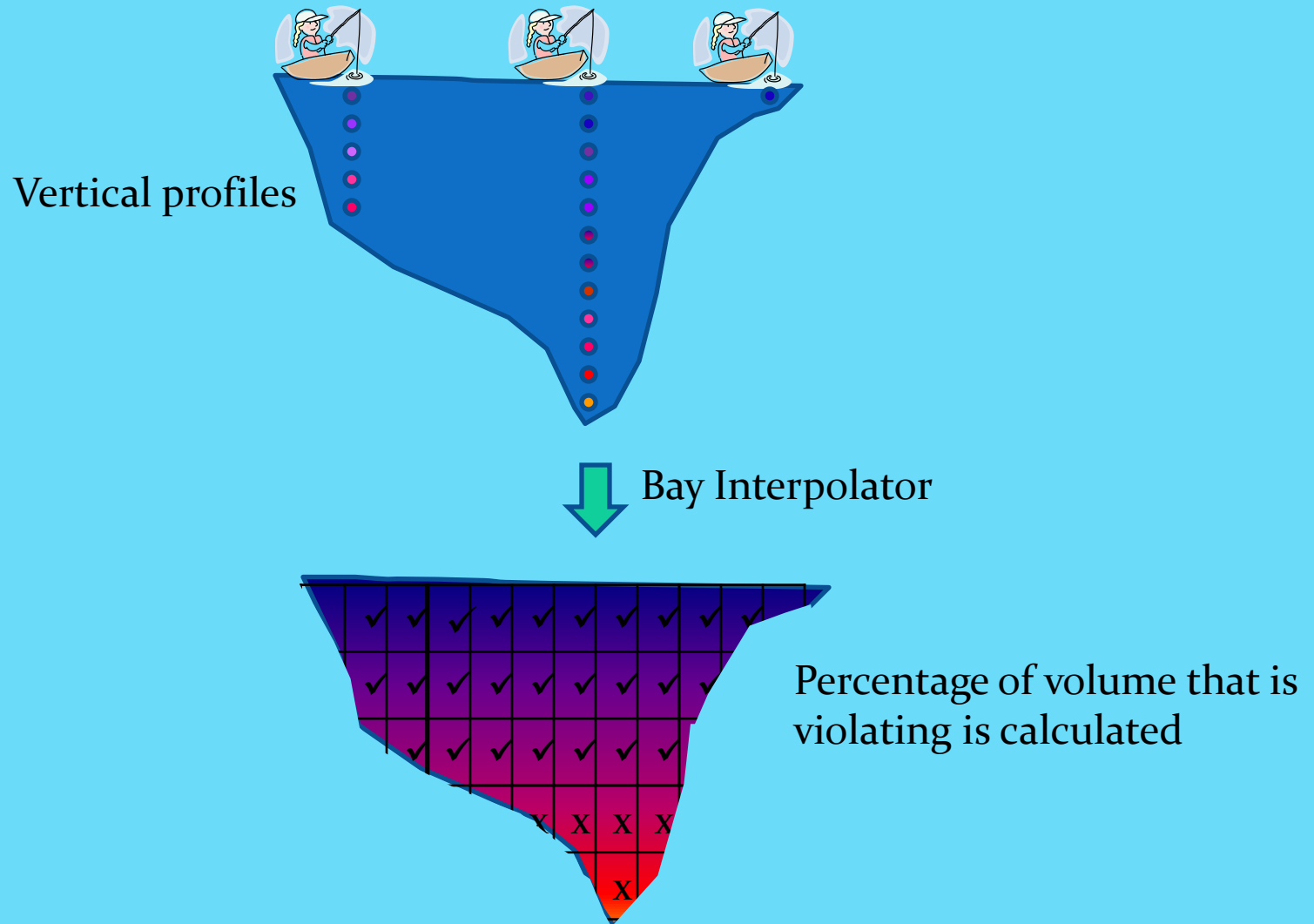
The current assessment methodology for the IM (Deep-Channel only)

Station data collected on the same day is interpolated spatially to create a picture of an “instant” in time.

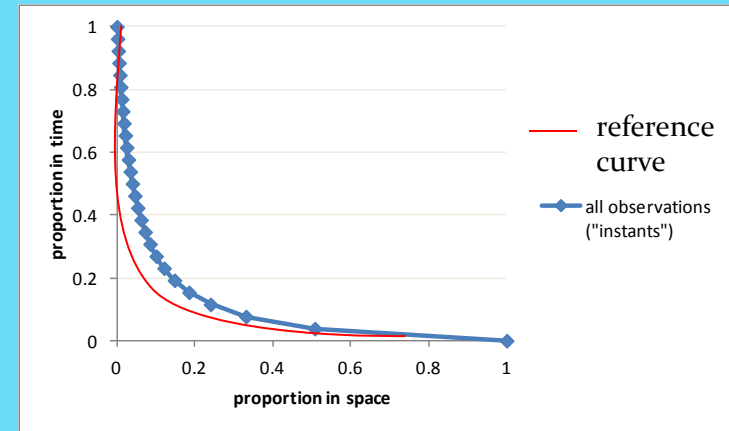
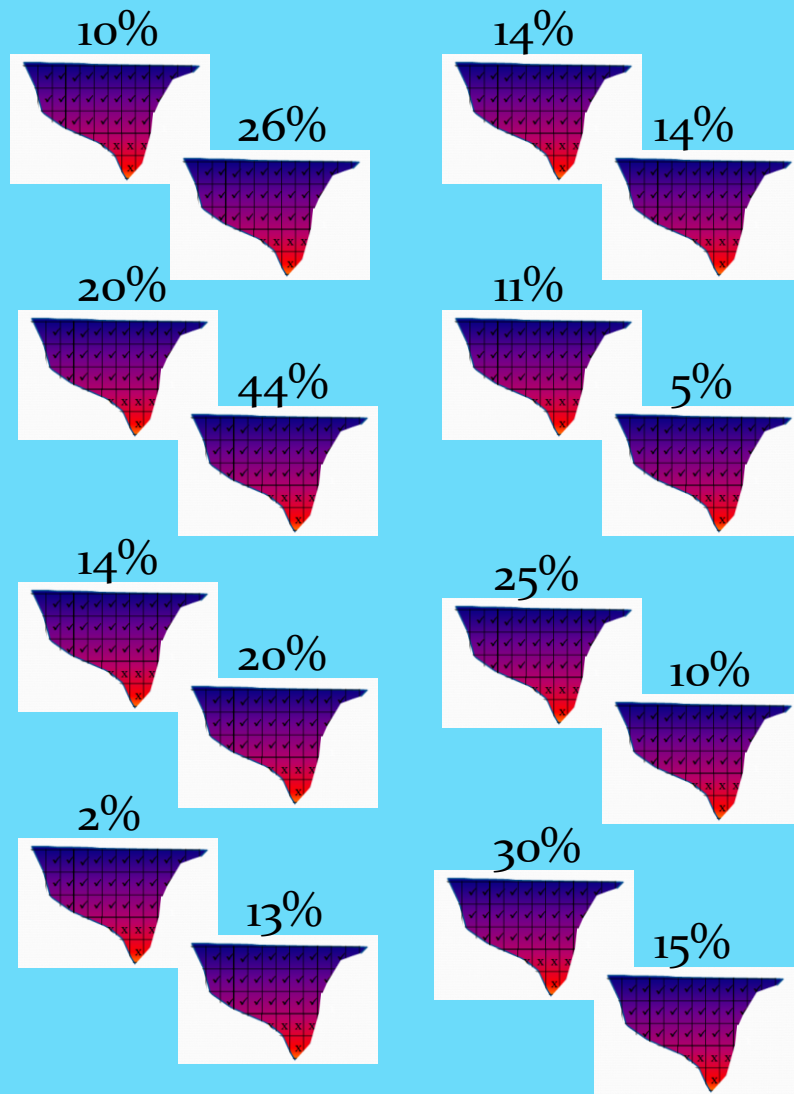


The current assessment methodology

Station data collected on the same day is interpolated spatially to create a picture of an “instant” in time.



The current assessment methodology



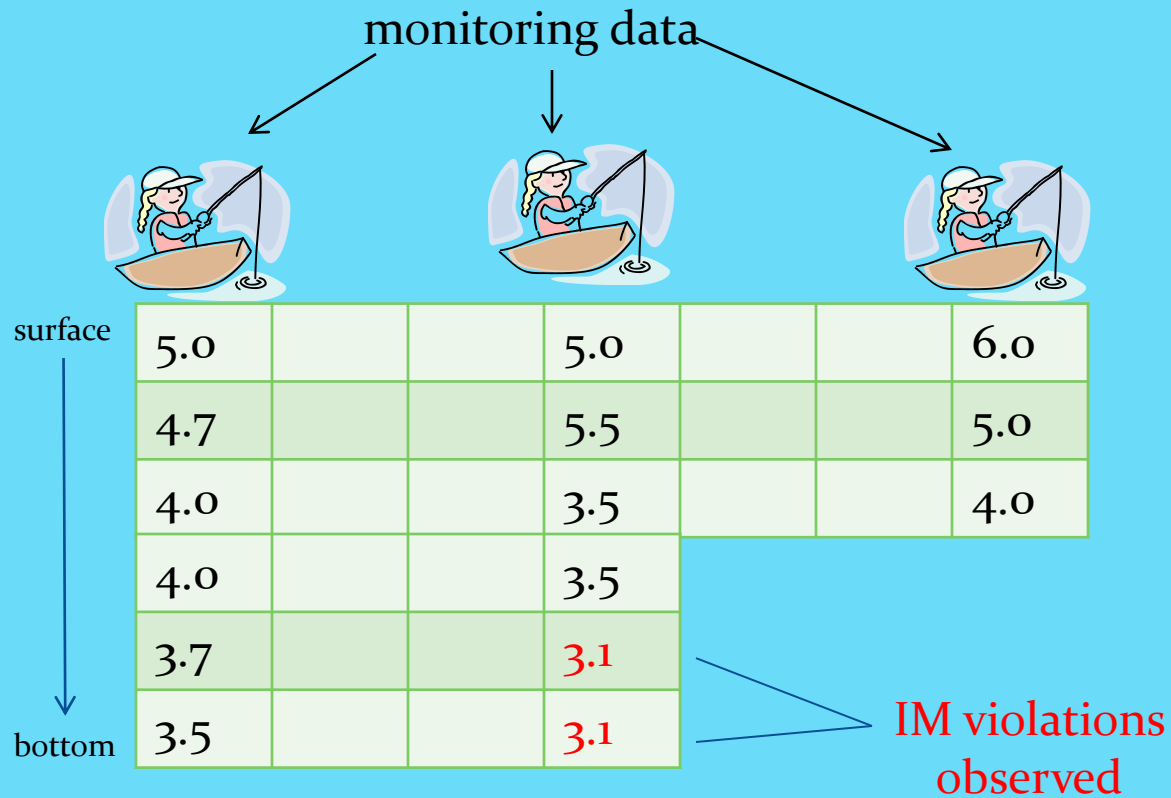
The violation rates for the “instants” are then used to create a CFD.

Applying this approach to the assessment of the Open-Water and Deep-Water Uses would require first addressing two issues:

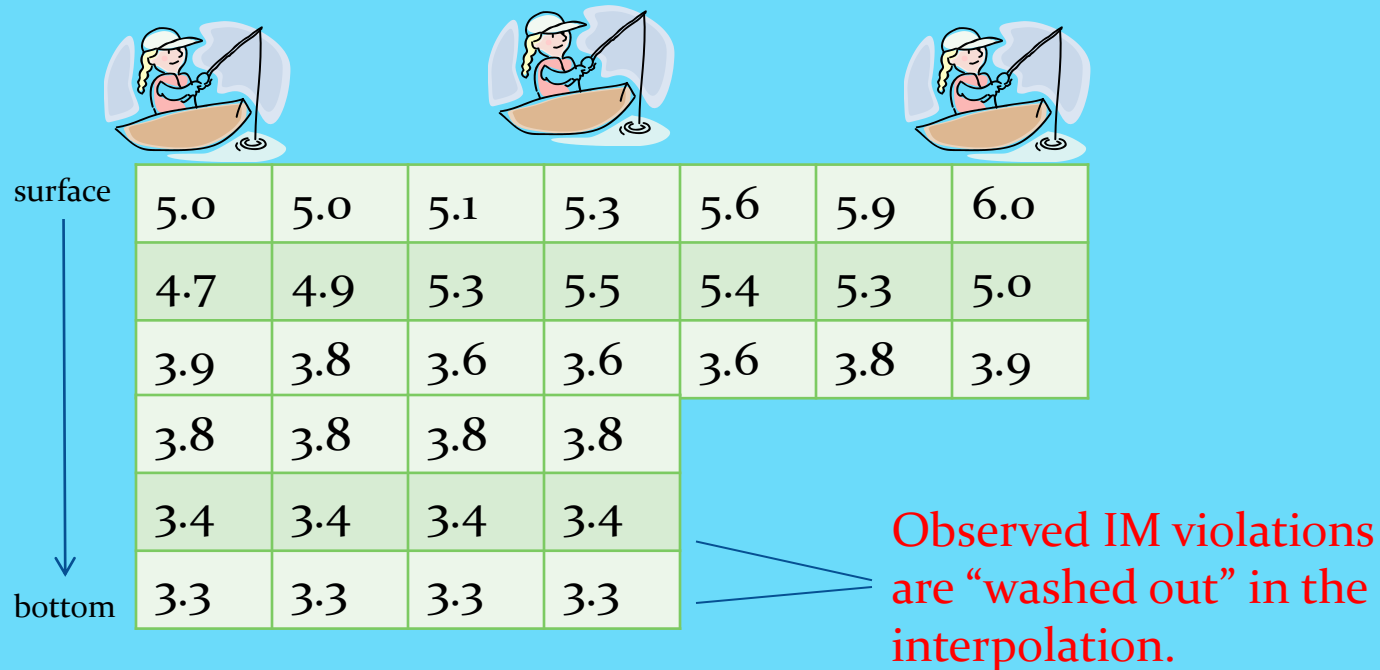
1. The current methodology does not require a minimum number of observations. Currently, a single observation can be used to characterize an entire segment.
2. We are assuming segments are more homogenous than they probably are.

Issue #1

So we don't have a rule for the minimum number of observations for each interpolation. What's the big deal?

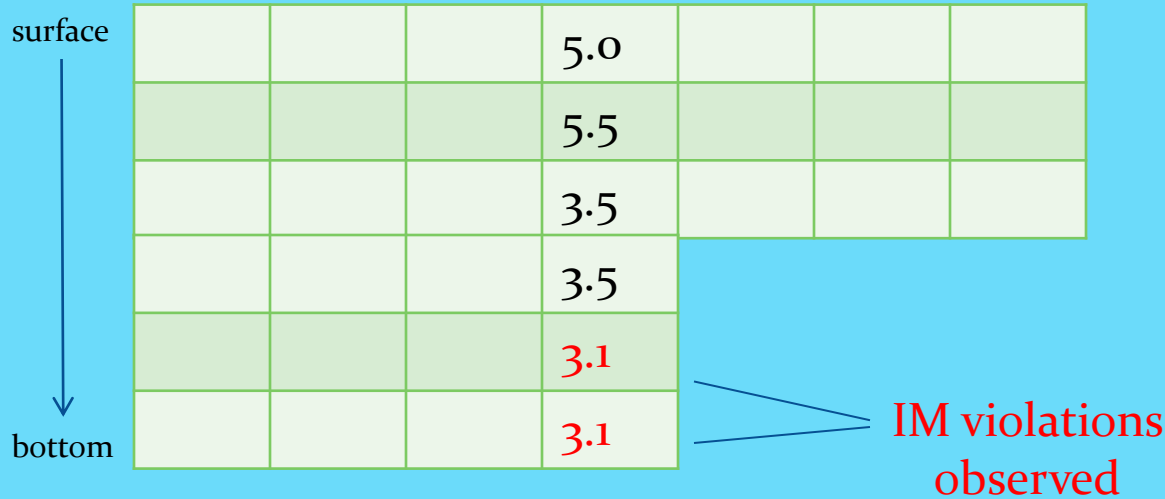


The Ideal :
Multiple vertical profiles used for an interpolation



Interpolation Estimates

monitoring data



The Not-Ideal :
A single vertical profile is used for an interpolation



surface

↓

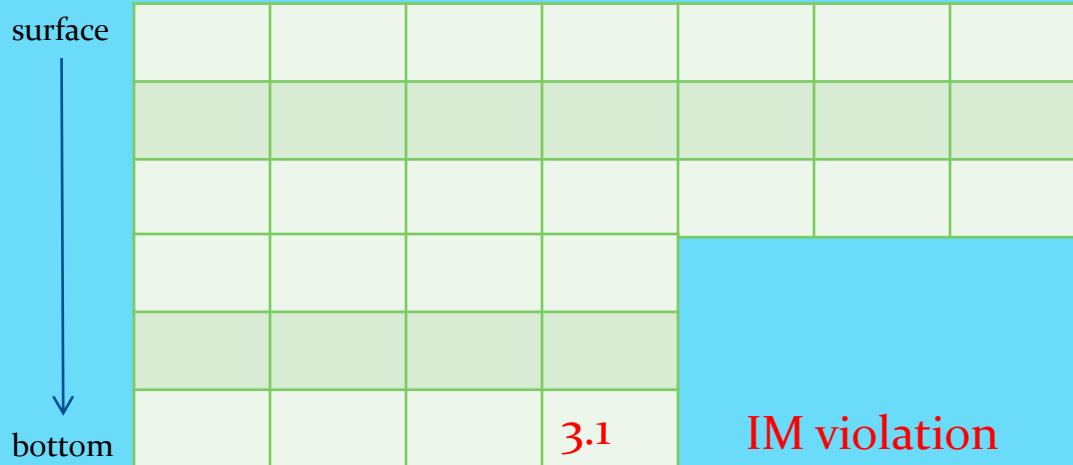
bottom

5.0	5.0	5.0	5.0	5.0	5.0	5.0
5.5	5.5	5.5	5.5	5.5	5.5	5.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5			
3.1	3.1	3.1	3.1			
3.1	3.1	3.1	3.1			

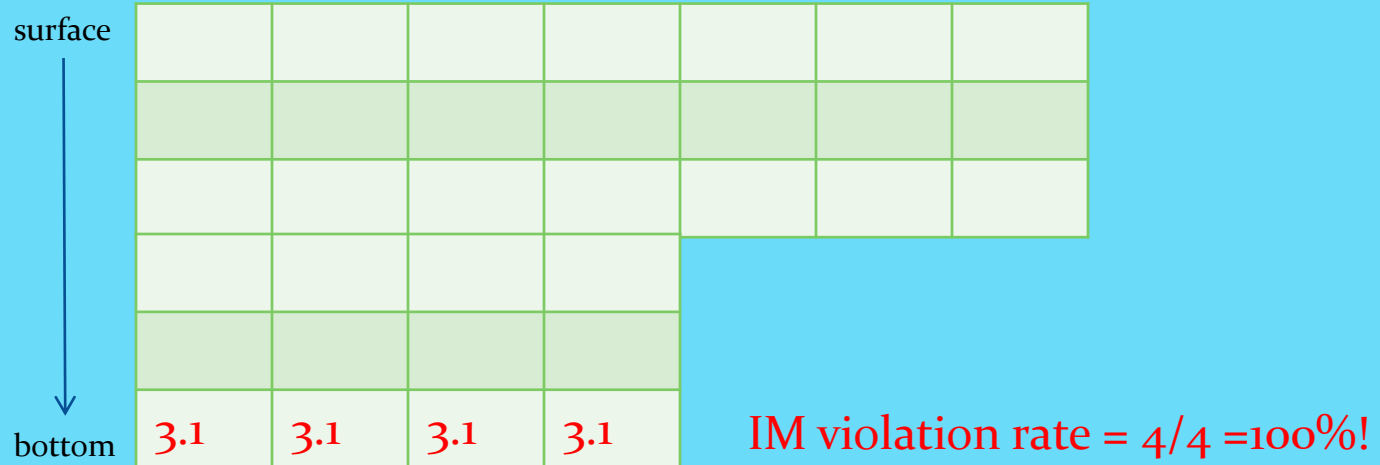
IM violation rate = $8/33 = 24\%$

Interpolation Estimates

(one vertical profile is assumed to be representative of the segment)



The Worst:
A single measurement is used for an interpolation

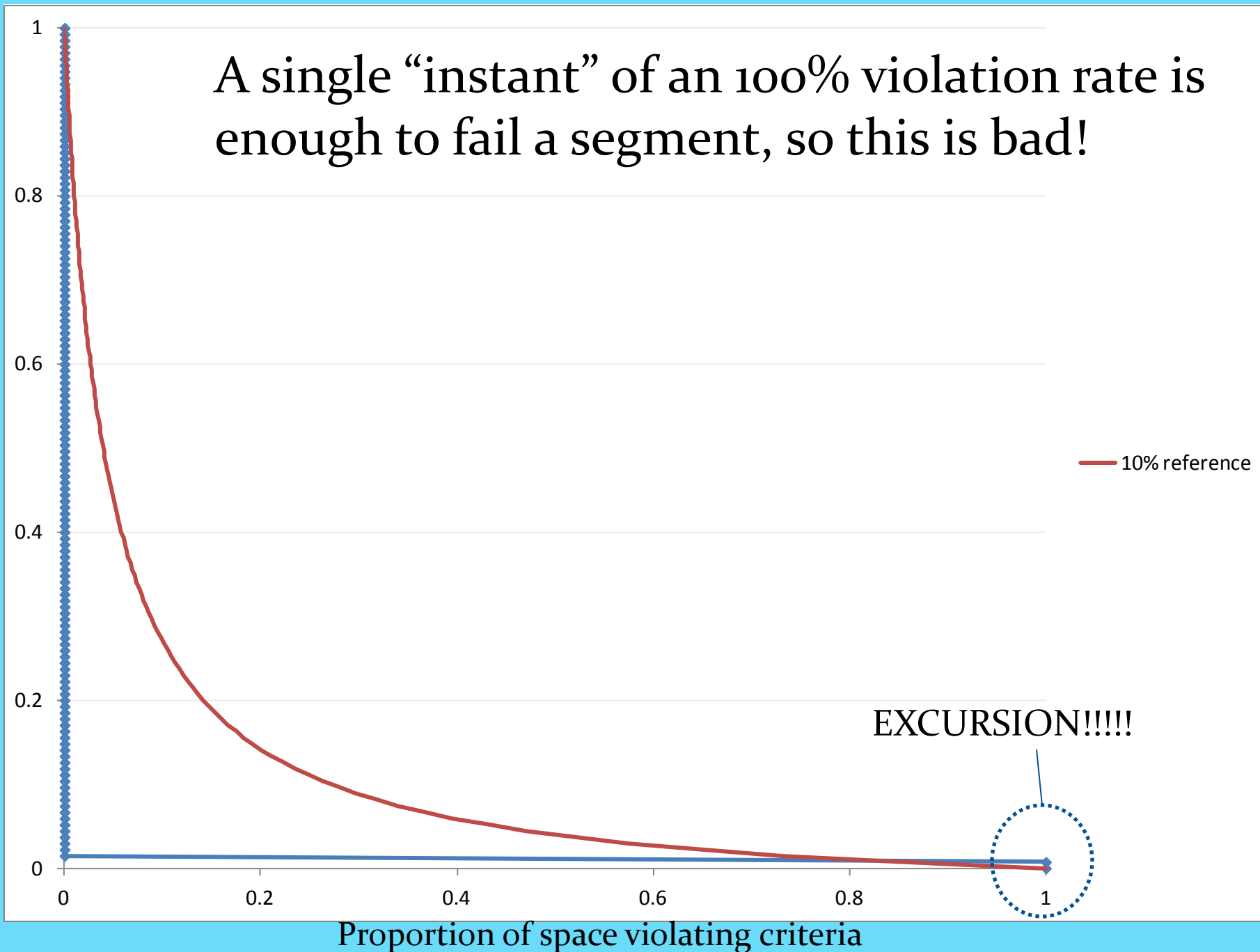


Interpolation Estimates

(a single measurement is assumed to be representative of a segment)

A single “instant” of an 100% violation rate is enough to fail a segment, so this is bad!

Proportion of time violating criteria

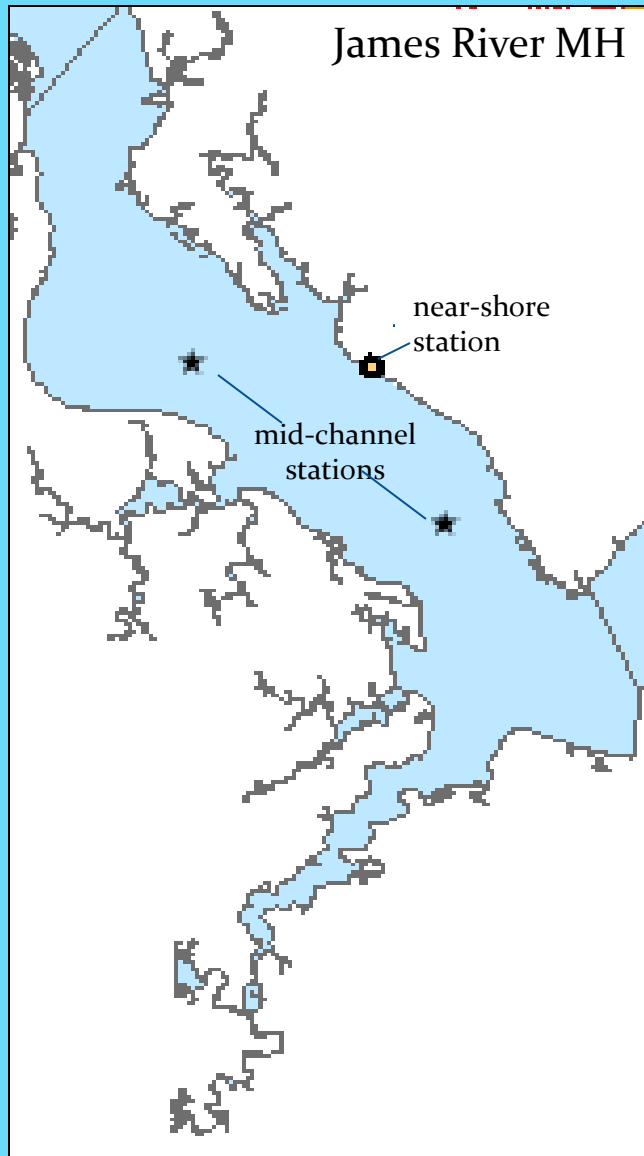


A number of segments could fail to meet the Aquatic Life Use just because of a single violation.

segment _{years analyzed}	Single fixed station IM violation?	Single COMMON IM violation?
JMSTF ₁ ₂₀₀₆₋₂₀₀₈	yes	no
JMSOH ₂₀₀₆₋₂₀₀₈	yes	no
JMSMH ₂₀₀₆₋₂₀₀₈	yes	yes
JMSPH ₂₀₀₆₋₂₀₀₈	no	yes
YRKPH ₂₀₀₈₋₂₀₁₀	no	yes
YRKM _H ₂₀₀₈₋₂₀₁₀	yes	yes
PMKOH ₂₀₀₈₋₂₀₁₀	no	yes
PMKTF ₂₀₀₈₋₂₀₁₀	yes	no
RPPMH ₂₀₀₇₋₂₀₀₉	yes	yes
RPPTF ₂₀₀₇₋₂₀₀₉	yes	yes
POTMH ₂₀₀₇₋₂₀₀₉	yes	yes
POTTF ₂₀₀₇₋₂₀₀₉	no	yes

Issue #2

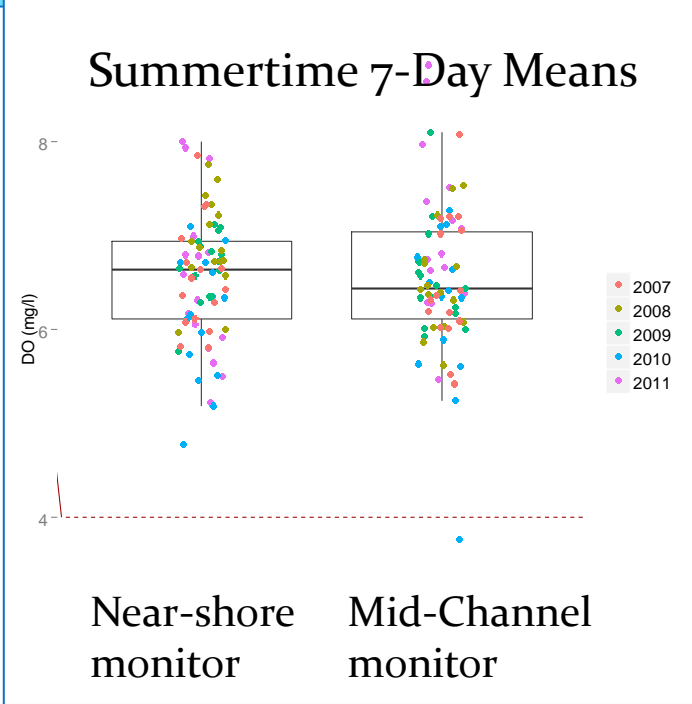
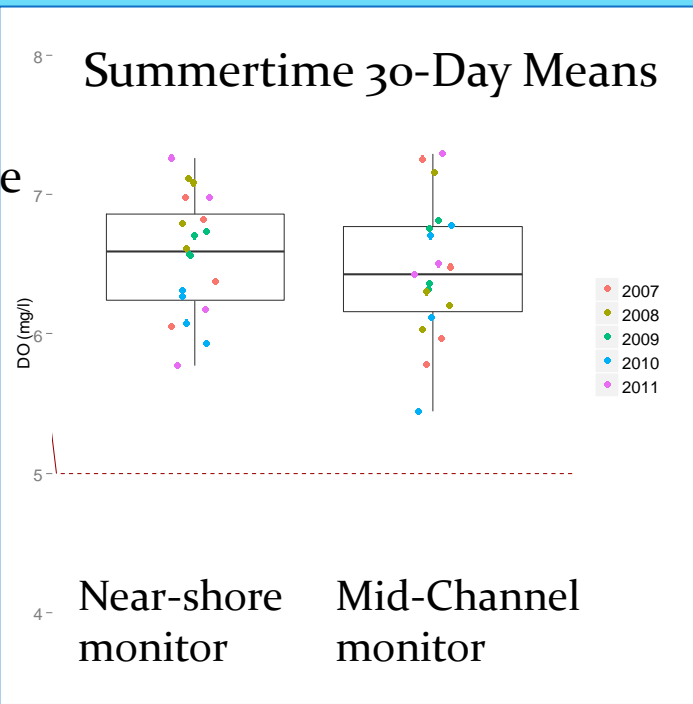
The Open-Water Use encompasses different habitats. Each assessed “instant” should be representative of the segment, but this will not always be the case.



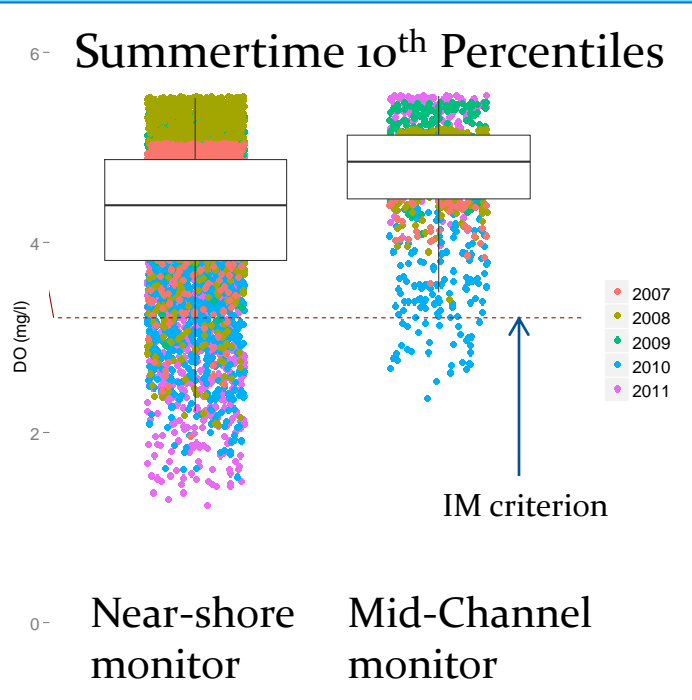
The different habitats that we're currently lumping together:

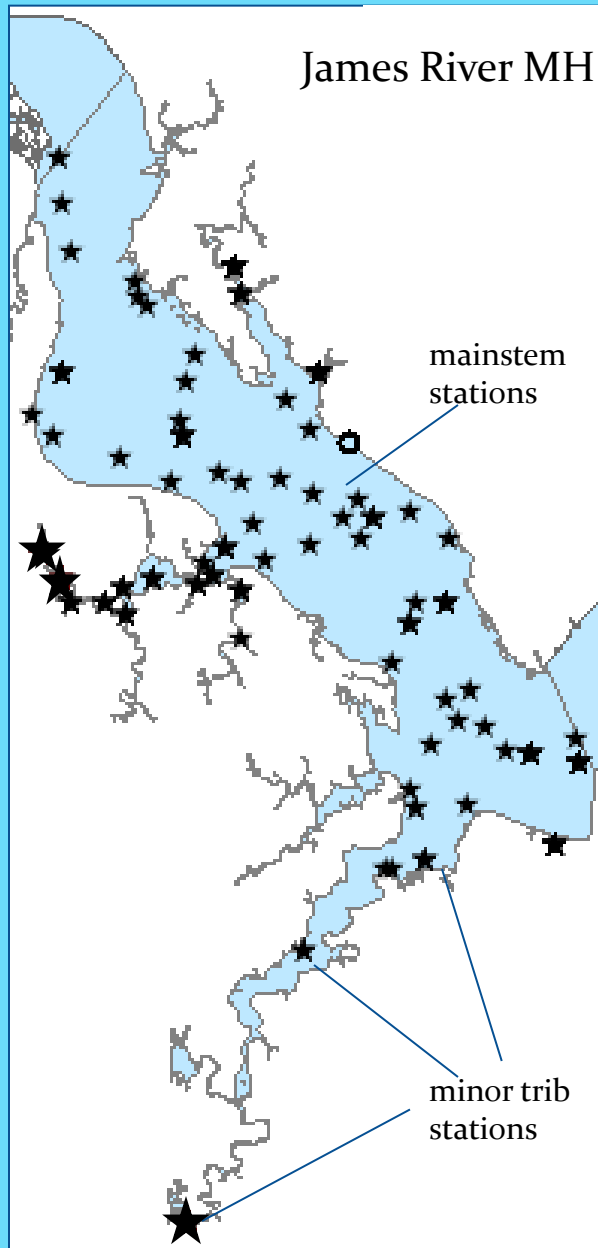
- near-shore versus mid-channel habitats

A comparison of means in York Polyhaline habitats using continuous monitors



Instantaneous minimum violations are more likely to show up in shallow, near-shore habitats, even when violation rates of the other criteria are similar.





The different habitats that we're currently lumping together:

- near-shore versus mid-channel habitats
- minor tributary versus major tributary



Example:

A citizen group collects data in the Nansemond River to get a “snapshot” of the river . However, the Interpolator will use these data to characterize the entire JMSMH segment. Poor conditions in the Nansemond can result in criteria non-attainment for the entire segment, even if the mainstem has good water quality overall.



In most assessments, the only instantaneous minimum violations observed at fixed stations in the JMSMH have occurred in the “extremities” of its minor tributaries.

Possible solutions to these issues?

- Establish a minimum number of “nearest neighbors” for each interpolation.

same day samples



surface

bottom

5.0			5.0			6.0
4.7			5.5			5.0
4.0			3.5			4.0
4.0			3.5			
3.7			3.1			
3.5			3.1			

← These datasets would be interpolated and assessed.



surface

bottom

			5.0			
			5.5			
			3.5			
			3.5			
			3.1			
			3.1			

← This dataset would NOT be interpolated or assessed.

We could define an “instant” as a snapshot over a 24-hour period, and thus pool all data points collected on the same dates for each interpolation.

BUT

We already have a 1-Day Mean criterion for the Deep Water Use.



Possible solutions to these issues?

- Establish a minimum number of “nearest neighbors” for each interpolation.
- Limit the horizontal extent of interpolation around each data point.



To ensure that each assessed “instant” of a segment is a representative snapshot, we could establish a “minimum coverage” rule. In this example, we could decide the coverage is not representative enough of the entire JMSMH segment to be used in assessment.

This would result in the exclusion of a lot of data, though.

Recommendation: Develop another methodology better suited to the dynamics of DO in Open Water and Deep Water Uses.