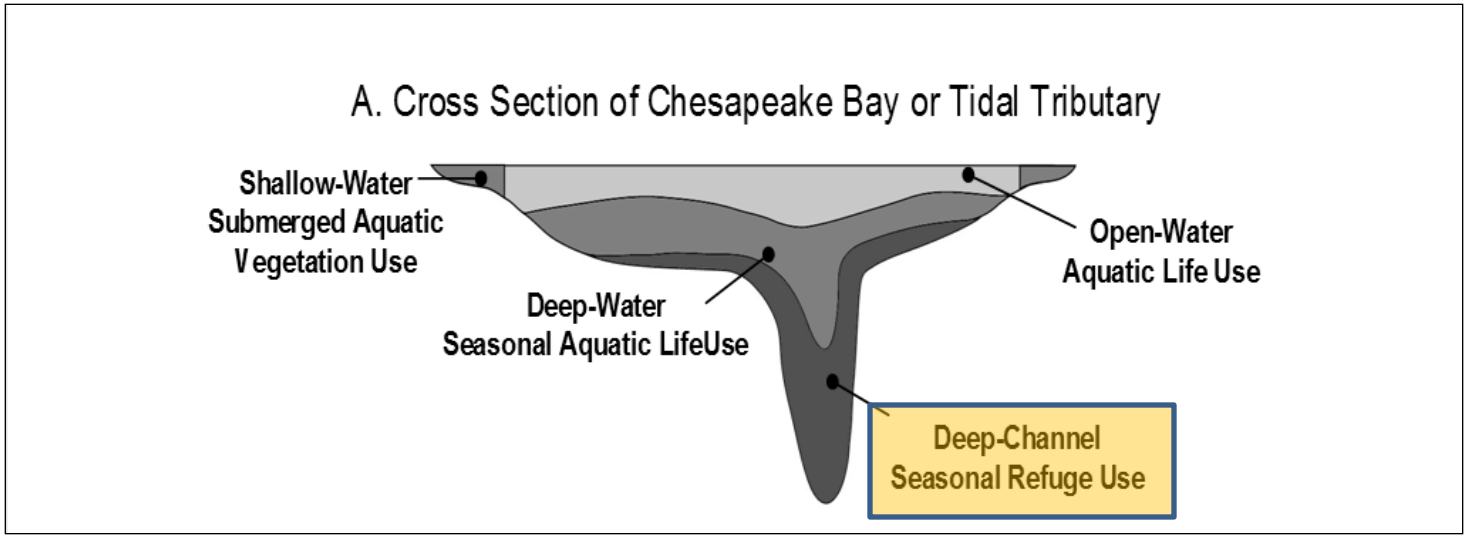
We already assess an instantaneous minimum!



Deep Channel Use has only one criterion: instantaneous minimum $\geq$ **1 mg/l**

What we don't have is assessment methodology for the Open Water and Deep Water IM criteria

Open-water fish and shellfish use[1]	30-day mean ≥ 5.5 mg liter^{-1} (tidal habitats with 0-0.5 ppt salinity)	Growth of tidal-fresh juvenile and adult fish; protective of threatened/endangered species.	Year-round
	30-day mean ≥ 5 mg liter^{-1} (tidal habitats with >0.5 ppt salinity)	Growth of larval, juvenile and adult fish and shellfish; protective of threatened/endangered species.	
	7-day mean ≥ 4 mg liter^{-1}	Survival of open-water fish larvae.	
	Instantaneous minimum ≥ 3.2 mg liter^{-1}	Survival of threatened/endangered sturgeon species.[2]	
Deep-water seasonal fish and shellfish use	30-day mean ≥ 3 mg liter^{-1}	Survival and recruitment of bay anchovy eggs and larvae.	June 1 - September 30
	1-day mean ≥ 2.3 mg liter^{-1}	Survival of open-water juvenile and adult fish.	
	Instantaneous minimum ≥ 1.7 mg liter^{-1}	Survival of bay anchovy eggs and larvae.	
	Open-water fish and shellfish designated-use criteria apply		October 1 - May 31
Deep-channel seasonal refuge use	Instantaneous minimum ≥ 1 mg liter^{-1}	Survival of bottom-dwelling worms and clams.	June 1 - September 30
	Open-water fish and shellfish designated use criteria apply		October 1 - May 31

How do the DC instantaneous min and OW/DW 30-Day assessment methodologies compare?

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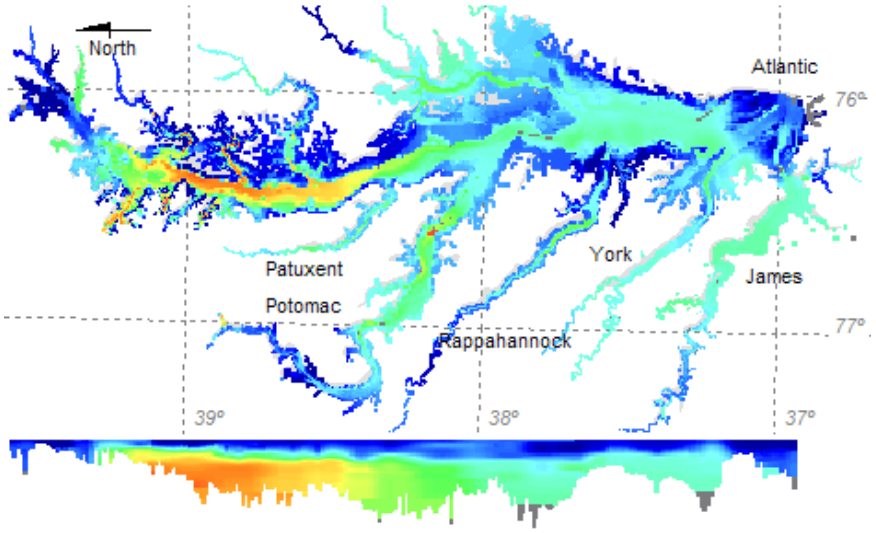
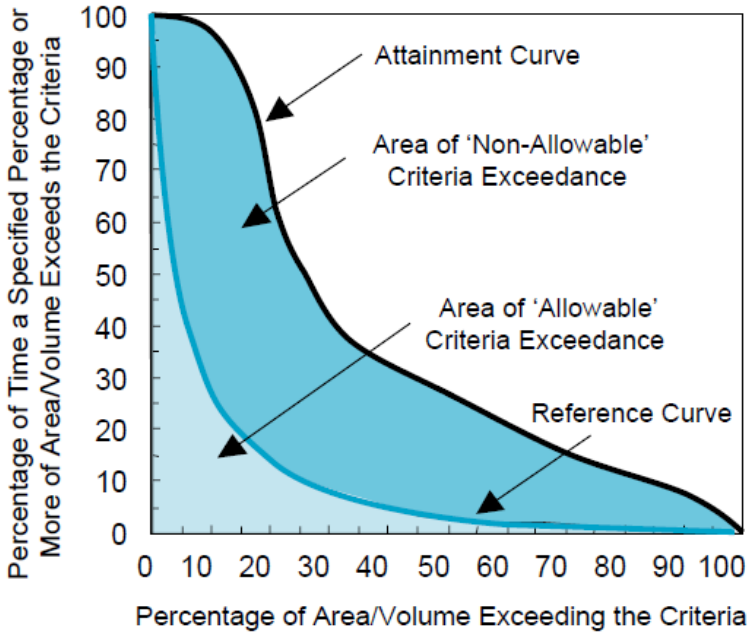
<u>Similarities</u>

- Bay Interpolator
- Cumulative Frequency Distribution (CFD)



Bay Interpolator



CFD

How do the DC instantaneous min and OW/DW 30-Day assessment methodologies compare?

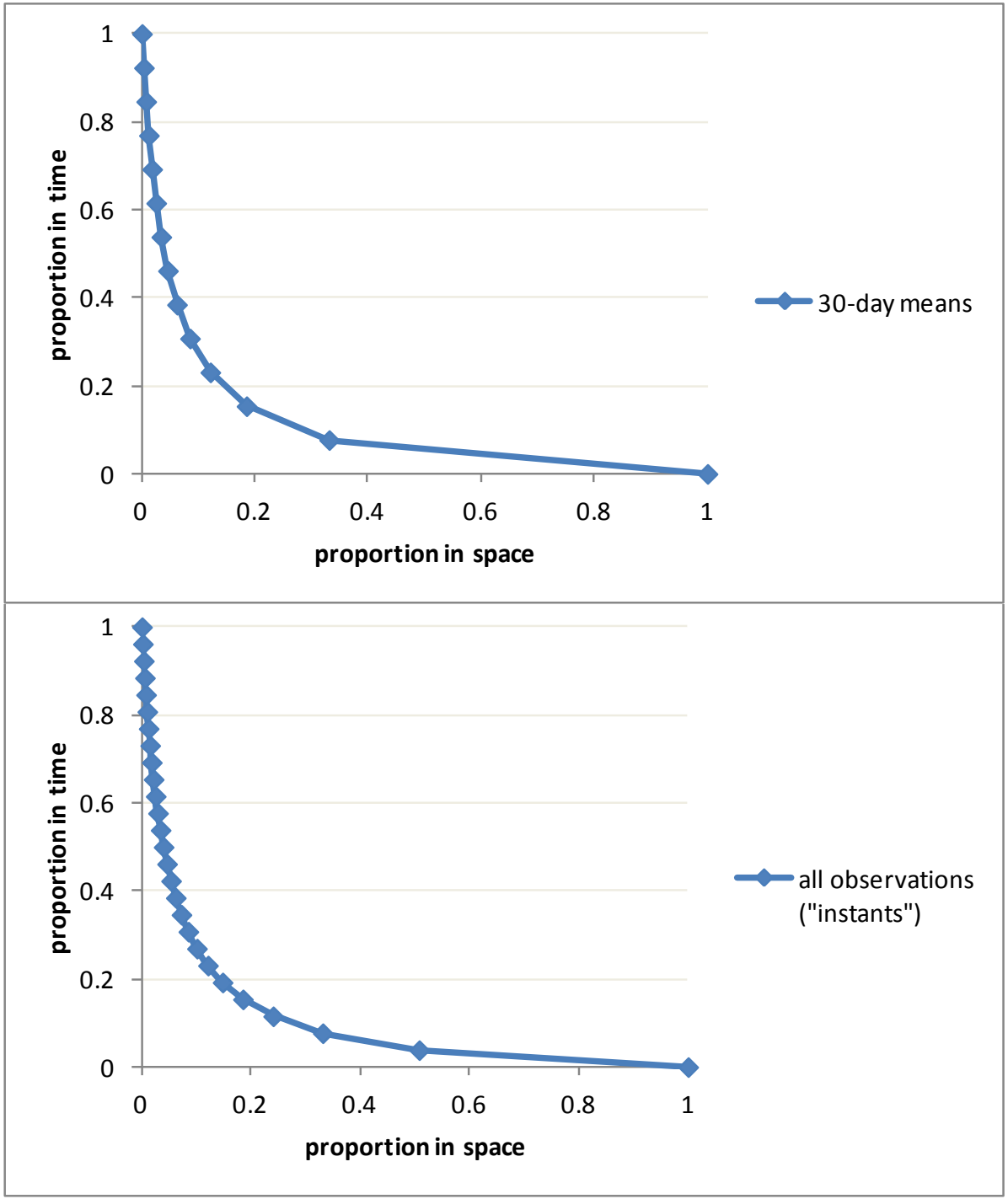
Similarities

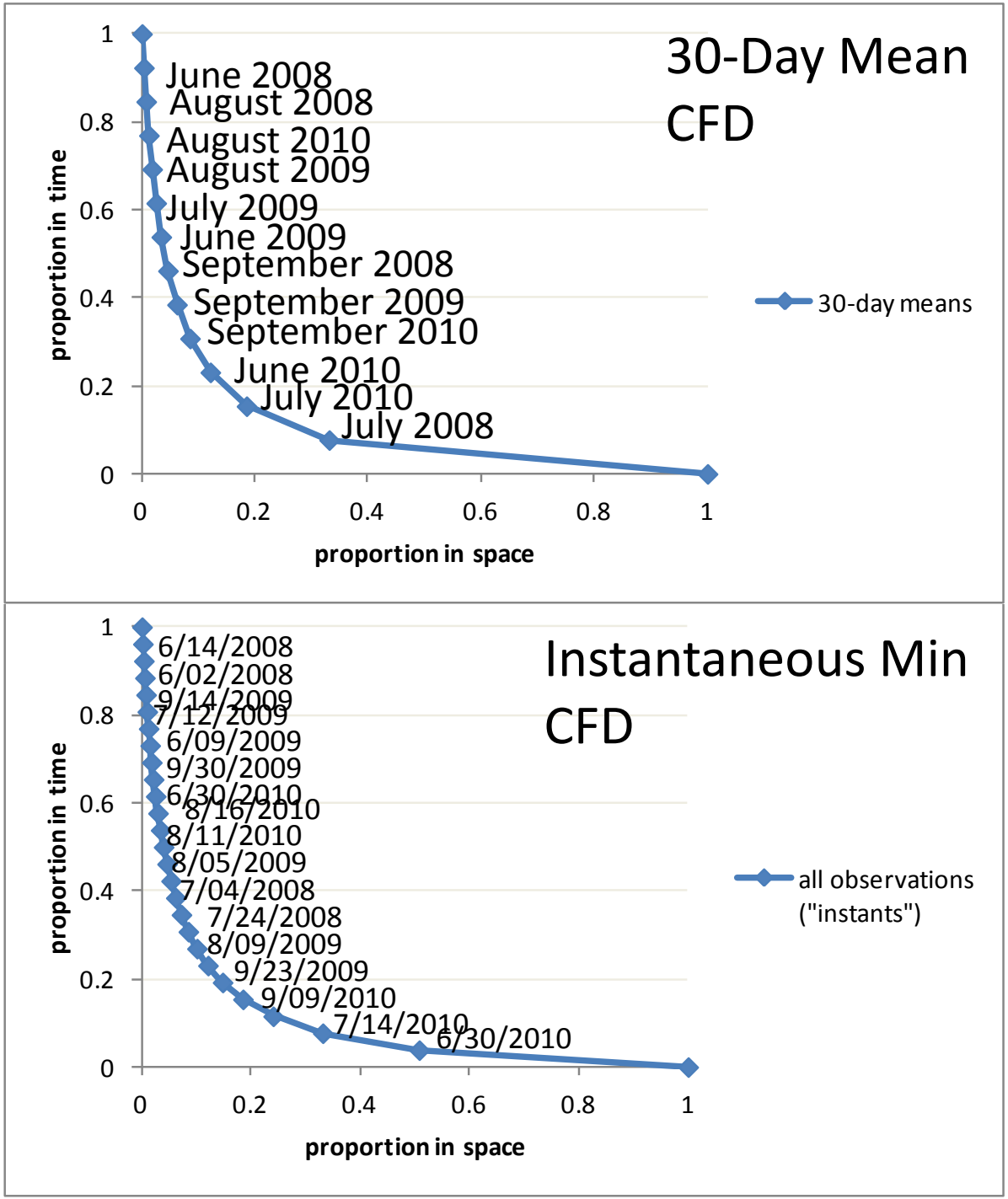
- Bay Interpolator
- Cumulative Frequency Distribution (CFD)

Differences

- 30-day mean: Criteria are assessed against spatially interpolated *monthly averages of station observations*.

- Instantaneous min: Criterion is assessed against spatially interpolated *station observations*.


1
0.8
0.6
0.4
0.2
0
proportion in time
0
0.2
0.4
0.6
0.8
1
proportion in space
30-day means
1
0.8
0.6
0.4
0.2
0
proportion in time
0
0.2
0.4
0.6
0.8
1
proportion in space
all observations
("instants")


30-Day Mean CFD
proportion in time
proportion in space
0
0.2
0.4
0.6
0.8
1
June 2008
August 2008
August 2010
August 2009
July 2009
June 2009
September 2008
September 2009
September 2010
June 2010
July 2010
July 2008
30-day means
Instantaneous Min CFD
6/14/2008
6/02/2008
9/14/2009
7/12/2009
6/09/2009
9/30/2009
6/30/2010
8/16/2010
8/11/2010
8/05/2009
7/04/2008
7/24/2008
8/09/2009
9/23/2009
9/09/2010
7/14/2010
6/30/2010
all observations ("instants")

Most salient difference between 30-day mean and IM CFDs:

- The 30-day mean CFD has a fixed number of time intervals (i.e., n = 12)
- The IM CFD is dependent on the number of observations.

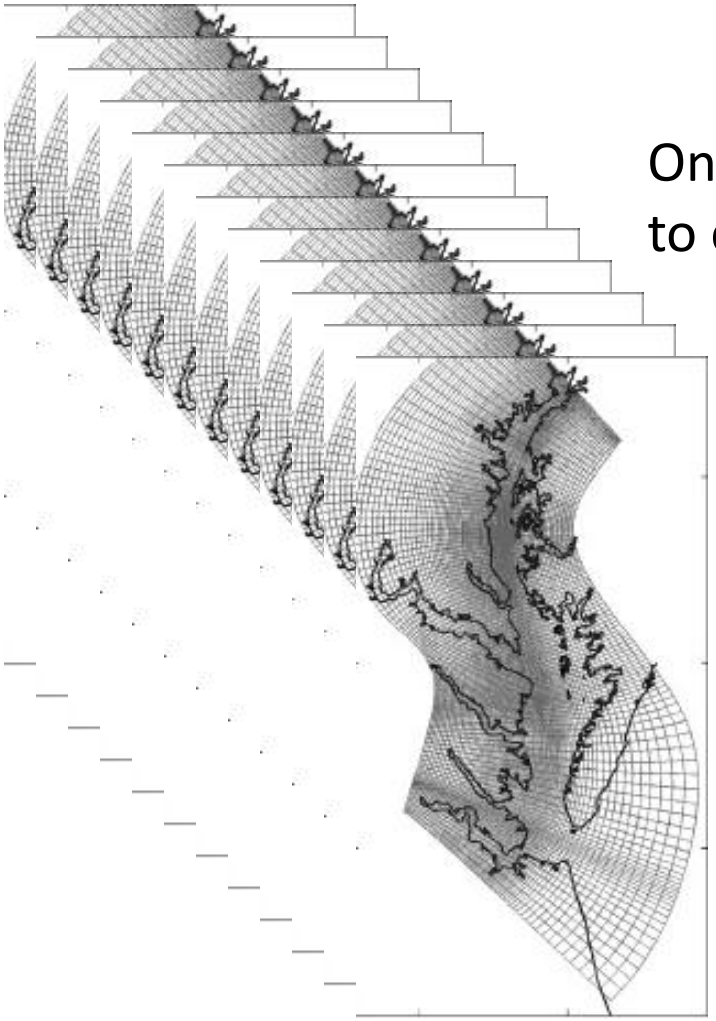
Most salient difference between 30-day mean and IM CFDs:

- The 30-day mean CFD has a fixed number of time intervals (i.e., n = 12)
- The IM CFD is dependent on the number of observations.

Summertime monthly sampling @ fixed stations x 3 years = 12 data points for each segment

Summertime 15-min sampling @ continuous monitoring stations x 3 years = ~ 28,200 data points for each segment

It will require much computational legwork to do an assessment using continuous monitoring data and the CFD framework.



Only 12 spatial interpolations are typically used to construct a monthly CFD.

~28, 200 spatial interpolations would be required to construct a CFD from continuous monitoring data!

We can generate 28,200 interpolations. Computers can do everything. So what's the big deal?

The problem I just discovered:

No matter what is defined as the “allowable violation rate”, most segments will fail the IM criteria if the current approach is used.

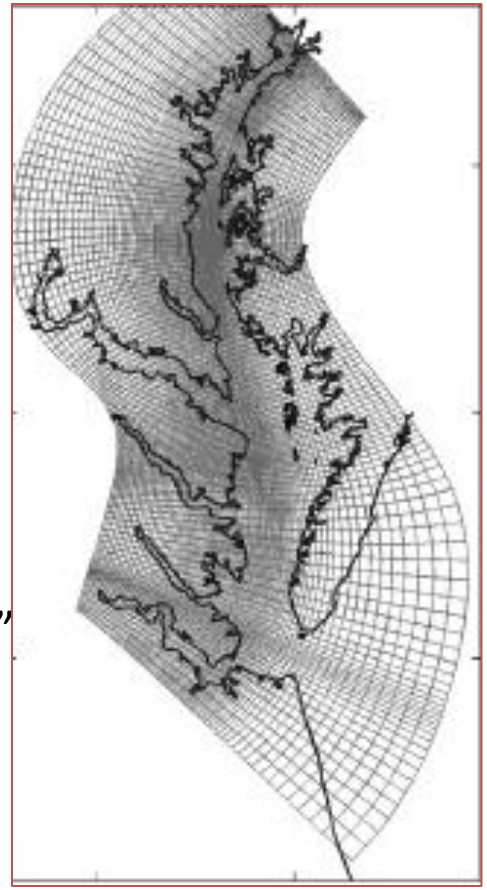
The simplicity of the Interpolator is at the crux of the matter.

How does the Bay Interpolator work?

- Every Bay segment is partitioned into cells (horizontally and vertically)

- The program generate estimates for each cell, using empirical monitoring data.

- It averages all data points within a pre-defined spatial neighborhood, with closer data points having more "weight" to a cell's estimate than those farther away. (Inverse Distance Weighting does NOT model the spatial variability of the dataset—which is what kriging does.)



Example: (Pretend we are looking at a cross section of a “gridded” segment)

Monitoring Station X

Monitoring Station Y

5.0									6.0
3.0									4.0
2.0									1.0

Interpolator

5.5	5.5	5.5	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
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

Example: (Pretend we are looking at a cross section of a “gridded” segment)

Monitoring Station X

Monitoring Station Y

5.0									6.0
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2.0									1.0

Interpolator

5.5	5.5	5.5	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
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

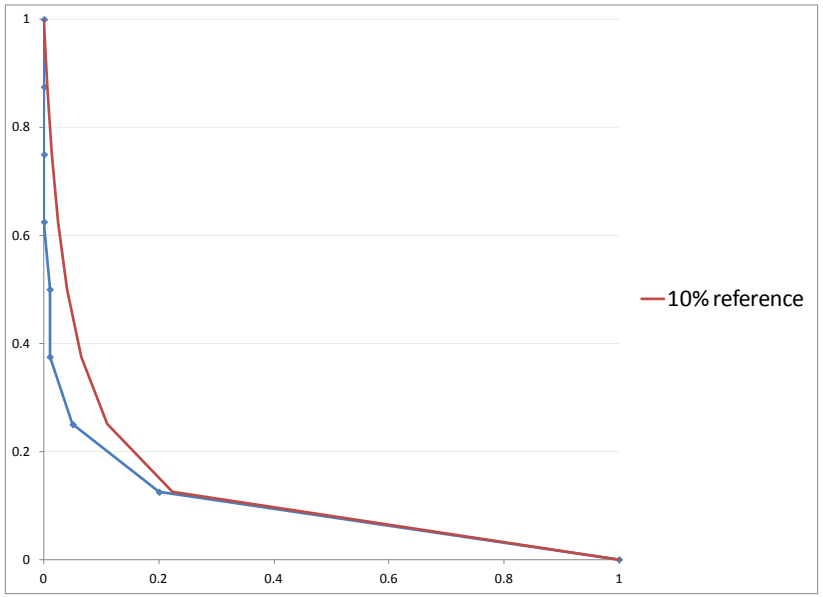
10 violations ÷ 30 estimates = 33 % violation rate

INTERPOLATIONS

"Space" violation rates

										= >33%
5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	= >20%
3	5.5									=>10%
	5.5	8.9	9.5	7.5	4.4	5.3	5.2	5.5	5.5	7.8	=>5%
5	3.5									
	1.5									=>0%
										=>1%
	3.5	3.8	3.5	5.4	5.1	5.5	5.4	5.5	5.5	5.5	4.3	=>1%
	4.6									
		3.5	6.5	7.8	7.8	7.8	4.5	5.6	5.8	5.7	6.0	5.5
		2.5	5.5	5.2	4.5	5.5	6.5	3.5	3.5	3.5	3.5	6.5	=>0%
			5.5	5.5	6.5	6.5	7.5	4.4	3.6	6.7	4.5	3.5

Violation rate in time



Violation rate in space

How does the Interpolator handle a single observation?

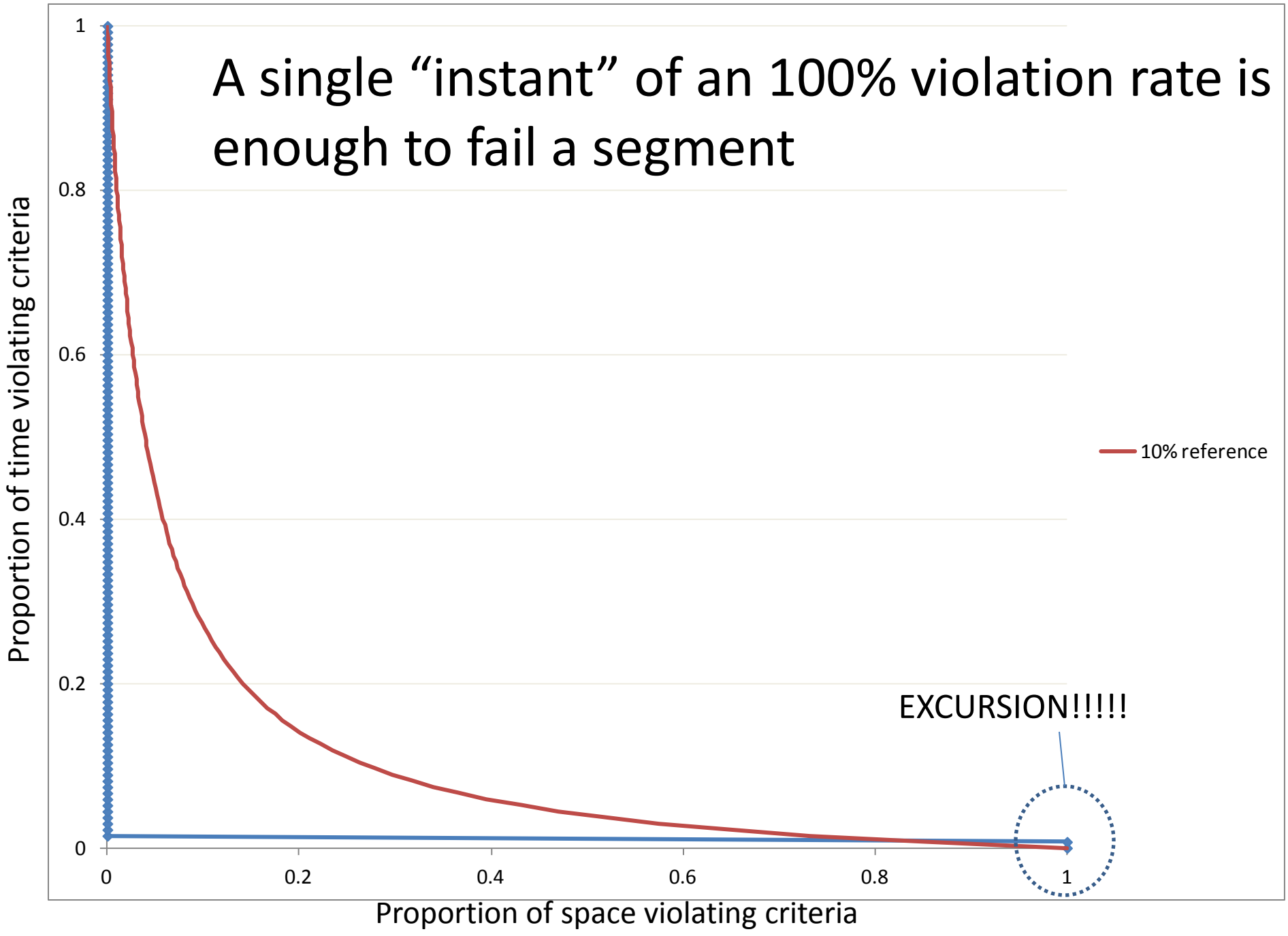
surface grab

				2.0					

Interpolator

2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

100 % violation rate!


A single “instant” of an 100% violation rate is enough to fail a segment
Proportion of time violating criteria
Proportion of space violating criteria
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
10% reference
EXCURSION!!!!!

The 30-Day Mean assessment is not as sensitive to isolated exceedences because interpolations are averaged by month and THEN assessed.

2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

July 4

6.5	7.8	7.8	7.8	4.5	5.6	5.8	5.7	6.0	5.5
5.5	5.2	4.5	5.5	6.5	3.5	3.5	3.5	3.5	6.5
5.5	5.5	6.5	6.5	7.5	4.4	3.6	6.7	4.5	3.5

July 18

4.3	4.9	4.9	4.9	3.3	3.8	3.9	3.9	4.0	3.8
5.5	5.2	4.5	5.5	6.5	3.5	3.5	3.5	3.5	6.5
5.5	5.5	6.5	6.5	7.5	4.4	3.6	6.7	4.5	3.5

July Average

The chance that a continuous monitor will observe a violation of the IM over a three-year period is pretty high , even for segments with good water quality.

If a continuous monitor observes a IM violation at an “instant” when no other data are collected in a segment (extremely likely), the segment will automatically fail the criterion, no matter how many observations are collected during the three-year assessment window.

Similarly, if a IM violation is observed at a fixed station at an “instant” when no other data are collected, the segment will automatically fail the criterion.

segment$_{\text{years analyzed}}$	single fixed station IM violation?	single CONMON IM violation?	Currently Fails OW 30-day Mean?
JMSTF1$_{2006\text{-}2008}$	yes	no	yes
JMSOH$_{2006\text{-}2008}$	yes	no	no
JMSMH$_{2006\text{-}2008}$	yes	yes	no
JMSPH$_{2006\text{-}2008}$	no	yes	no
YRKPH$_{2008\text{-}2010}$	no	yes	yes
YRKMH$_{2008\text{-}2010}$	yes	yes	yes
PMKOH$_{2008\text{-}2010}$	no	yes	no
PMKTF$_{2008\text{-}2010}$	yes	no	no
RPPMH$_{2007\text{-}2009}$	yes	yes	yes
RPPTF$_{2007\text{-}2009}$	yes	yes	no
POTMH$_{2007\text{-}2009}$	yes	yes	no
POTTF$_{2007\text{-}2009}$	no	yes	no

The problem is compounded by the fact that not all interpolations are based on representative data.

In this segment, IM violations tend to cluster in minor tributaries where water quality tends to be much worse than it is in the mainstem. If a sample is taken in one of these tribs in isolation , the entire segment will be represented by that sample in the Interpolator.

★ Location where IM violations were detected 2006-2008.

Conclusion:

The “direct evaluation” approach that we currently use for the 30-day mean assessment is probably not appropriate for the IM. I don’t think this necessarily means we HAVE to use modeling, but I think our assessments will be more accurate if we could start using what we know about variability.

Alternatives: Logistic regression, spectral analysis, others?