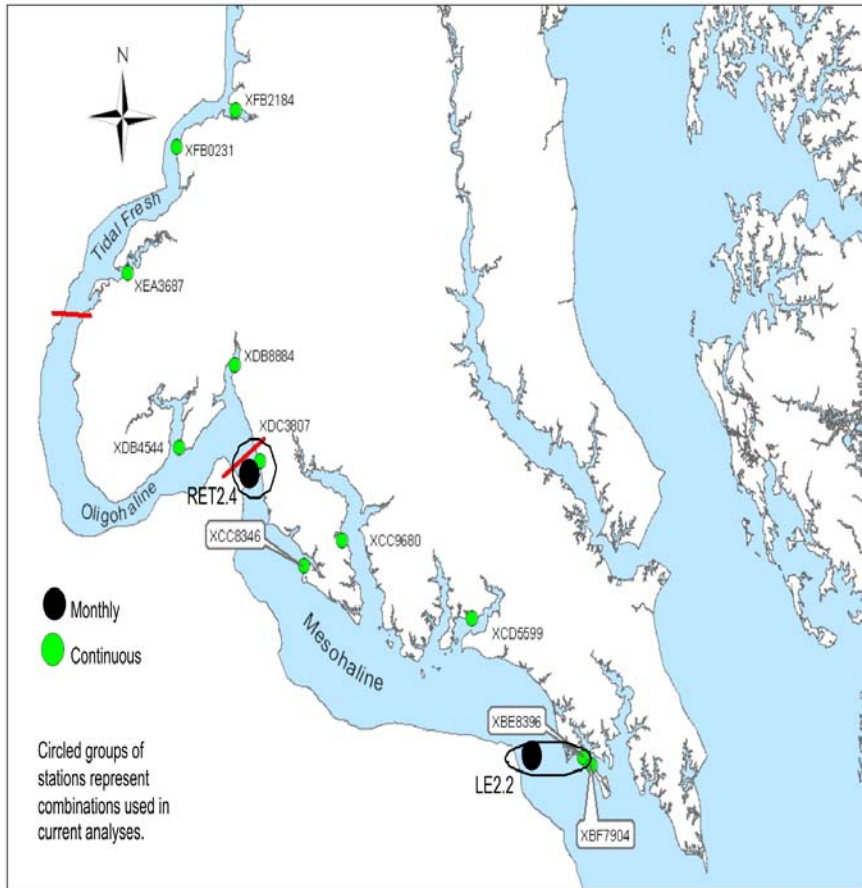


**Application of Spectral Casting:
Lower Potomac River Test Case and Comments
on Deep Water Analysis**

**Chesapeake Bay Dissolved
Oxygen Umbrella Criterion
Workshop
March 16, 2011**

Matthew Hall

Lower Potomac River case study

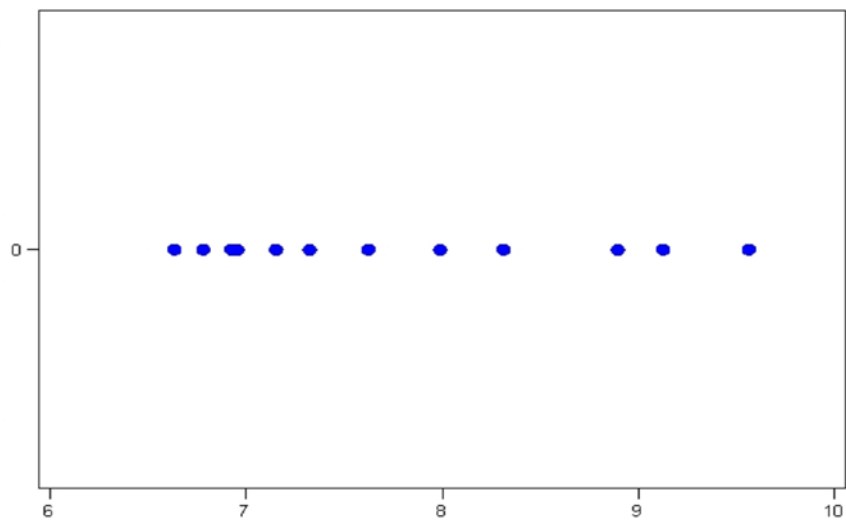


- Datasets trimmed to common temporal window (April-October) 2006-2008.
- Lower station is Piney Point; upper at Pope's Creek. Both in POTMH segment.

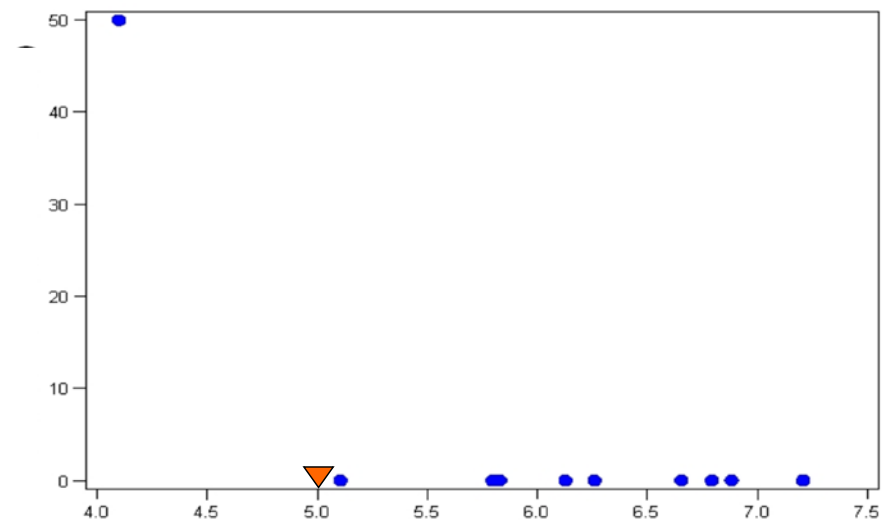
Is the 30-day mean criterion protective of the 7-day mean criterion?

Frequency of 7-day means failing 7-day criterion (4 mg/L)

Piney Point



Pope's Creek



30-day mean synthetic DO (mg/l)

Questions about spectral analysis methodology

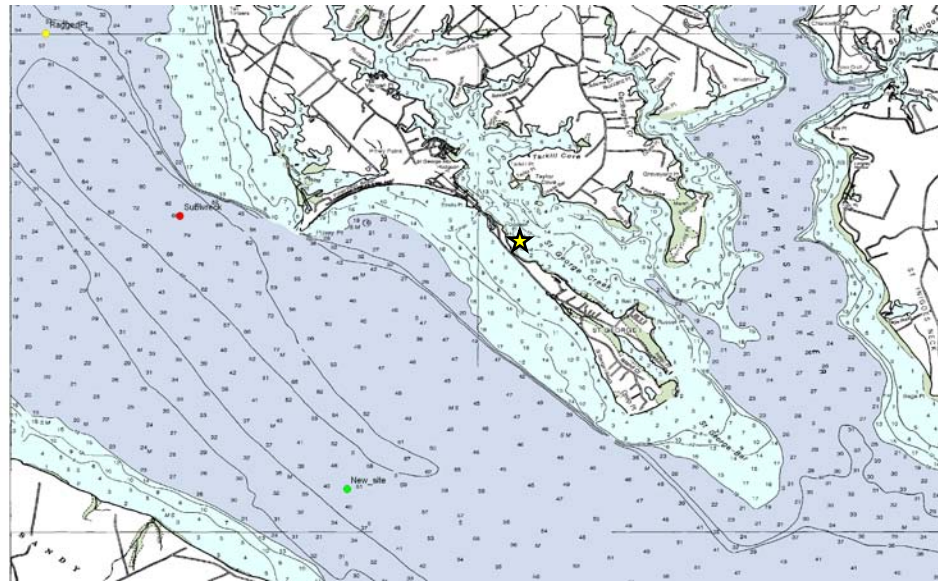
1. How does modeling long-term open water monitoring station data synthetically with short term continuous monitoring data match up with actual short term data from open water stations?
2. Is it appropriate to use surface continuous monitoring data to synthetically model deeper open water profile data?
3. What does short term open water data tell us about the umbrella criterion?

DNR vertical profiler was successfully deployed in the lower Potomac River in 2009.



Methodology

- Sampled vertical profiler data monthly at each depth. This served as a proxy open water fixed station dataset (profiler sampled every 3 h).
- Used spectral analysis to create synthetic dataset with nearby continuous monitor at St. George's Creek.
- Tested the frequency of each criterion (30 day mean, 7 day mean, instantaneous minimum) failing at each depth.
- Compared these failure frequencies with the frequencies of failure for the continuous profiler data at each depth (1,3,5,7,9,and 11 m).
- Tested for pycnocline and used deep water criteria at appropriate depths.



Frequency of failing DO criteria 30-day mean (moving average)

Used data between June 22 and August 16 for all comparisons due to data gaps

	Depth	Synthetic data %	Profiler continuous data %
Open water 5 mg/L	1 m	0	0
	3m	0	0
	5m	0	0
Deep water 3 mg/L	7m	100	100
	9m	100	100
	11m	100	100

Frequency of failing DO criteria

7-day mean (moving average) open water

1-day mean (moving average) deep water

Used data between June 22 and August 16 for all comparisons due to data gaps

Depth	Synthetic data %	Profiler continuous data %
1 m	0	0
3m	0	0
5m	0	0
7m	96.67	30.3
9m	100	100
11m	100	100

Open water
4 mg/L

Deep water
2.3 mg/L

Frequency of failing DO criteria

Instantaneous minimum

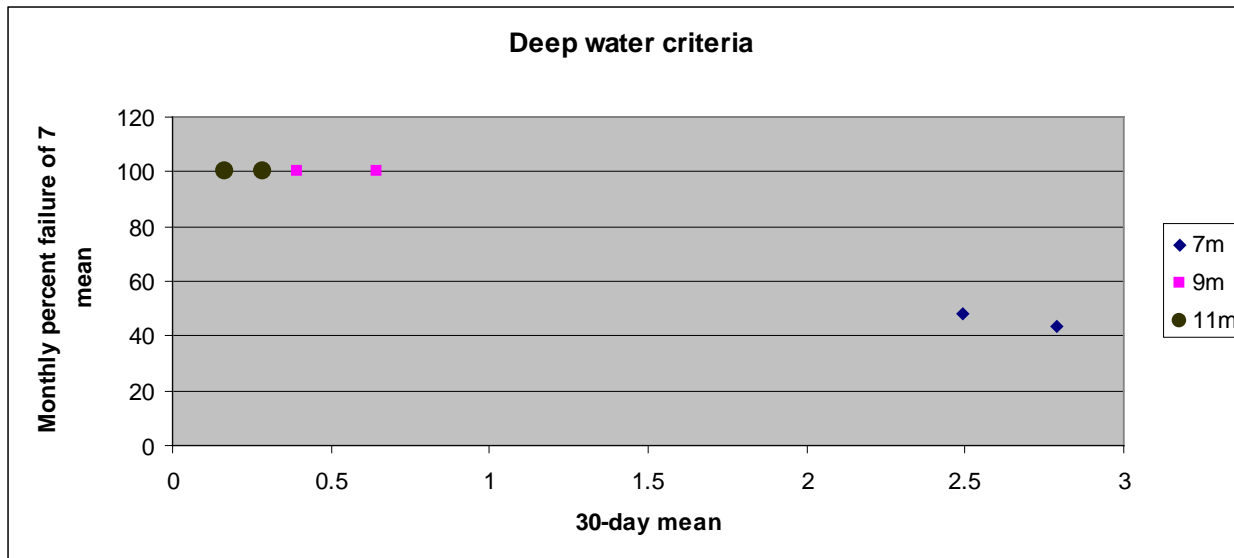
Used data between June 22 and August 16 for all comparisons due to data gaps

Depth	Synthetic data %	Profiler continuous data %
1 m	0	2.68
3m	0	3.13
5m	0	6.5
7m	60.57	41.87
9m	69.49	88.57
11m	92.11	96.9

Open water
3.2 mg/L

Deep water
1.7 mg/L

- Did the 30-day mean criterion protect the 7-day mean criterion? In both the synthetic and real profiler datasets, it did for open water (no failures of either criterion). It also did for deep water in the real profiler data (below), but both monthly and 7-day means failed 100 percent of the time.

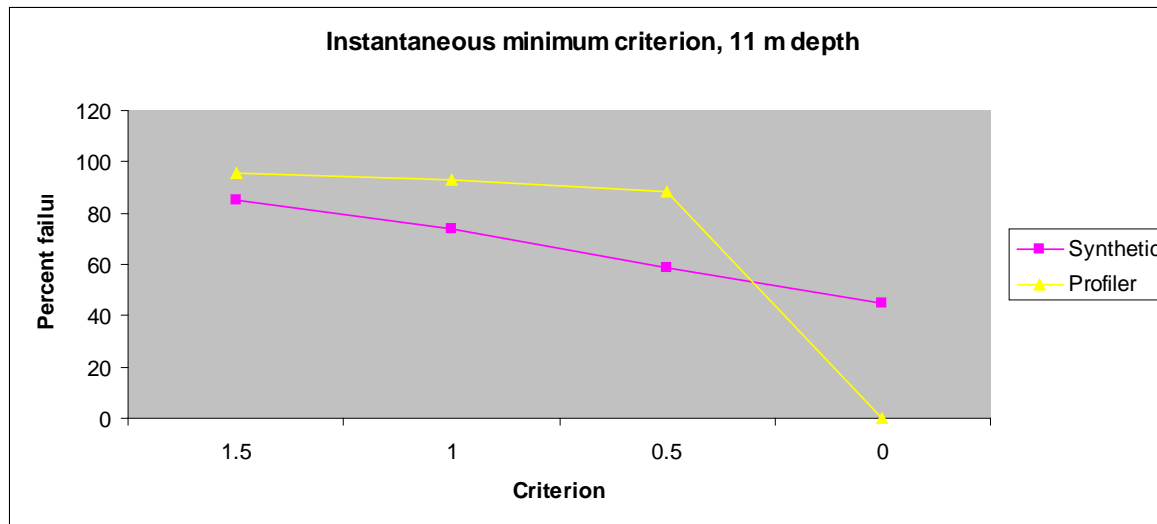
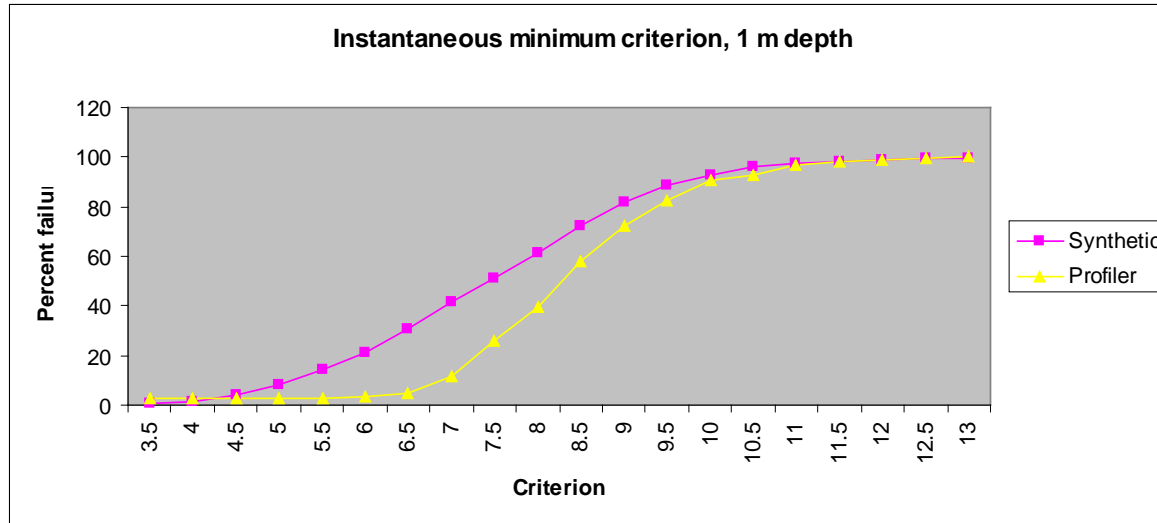


MARYLAND DEPARTMENT OF NATURAL RESOURCES

DO Umbrella Criteria Assessment

- For 30-day and 7-day mean criteria, above pycnocline, the synthetic data tracks well with continuous profiler data at all depths.
- The agreement is less for instantaneous minima, but not that far off.
- May not be appropriate to use synthetic datasets to evaluate deep water criteria, except perhaps the 30-day mean.
- Validates methodology (at this site, at least). Synthetic data seems to capture variability of open water continuous data.
- Umbrella criterion (30-day mean) seems to be protective of the 7-day mean criterion above pycnocline. However, the instantaneous minimum may not be protected.
- There were few violations above pycnocline and many below pycnocline. Were these criteria appropriate at this site?

Increasing criteria levels



		30-day mean (5 mg/L)			7-day mean (4 mg/L)			Instantaneous minimum (3.2 mg/L)		
Station	Year	Total hours <5 mg/L	Maximum duration, hours	Percent failure	Total hours <4 mg/L	Maximum duration, hours	Percent failure	Total hours <3.2 mg/L	Maximum duration, hours	Percent failure
Piney Point	2006	798	77.75	27.99	209.75	57.75	8.68	120	28.75	7.21
	2007	271.5	32.75	10.27	65.25	15	2.38	37.75	14.5	2.02
	2008	312.25	29.25	11.29	91	24.5	3	50.25	17.5	2.52
St. George's Creek	2006	541.25	26.25	18.43	91.75	11	4.24	31	10.75	1.94
	2007	664.75	38.25	22.76	71.5	12.25	4.79	23.75	4.25	2.43
	2008	930	22	32.75	141.25	18.25	9.95	59.5	15	7.75
Swan Point	2006	282	35.5	14.46	78.5	15.75	3.15	29.75	7	1.76
	2007	261.25	14	9.92	45.75	11	1.26	18.5	5.75	0.9
	2008	260.5	9.5	8.97	21.75	7.25	0.76	11.5	5.25	0.4
Wicomico Beach	2006	382.25	16.25	14.88	67	11	2.31	24.75	7.25	1.25
	2007	104.5	12.75	5.03	19.75	4.25	0.72	2.25	2	0.12
	2008	260	9.25	10.72	24.25	6.25	1.12	3.75	1.25	0.18
Breton Bay	2006	1093.75	79.25	38.38	267	26.5	16.95	141.5	24.75	12.44
	2007	1315.5	62	50.51	331.5	21.5	17.44	97.25	11.25	13.86
	2008	1534.25	95	54.95	437.75	65.25	26.33	254.25	40.5	22.64
Blossom Point	2006	167.5	19	11.7	18	4.25	1.08	0.25	0.25	0.07
	2007	9	2.5	0.35	0	0	0	0	0	0
	2008	24.5	2.25	0.84	0.75	0.5	0.03	0.75	0.5	0.03
Port Tobacco	2007	567	25.75	21.07	86.25	15.25	5.12	30.75	5.5	2.13
	2008	378.5	17.25	14.54	62.5	11.5	2.71	31.5	7	1.61
Popes Creek	2006	564.25	28	27.09	120.5	11.5	5.37	32.25	8.5	1.9
	2007	1168.5	39	40.47	198.75	14.5	7.81	75.5	10.5	4.26
	2008	867.75	22.5	36.33	149.25	10	7.84	54.5	8.5	4.68
Mattawoman Creek	2006	197	42.25	6.78	61.25	19.5	1.54	26	14.25	1.18
	2007	206.75	13.25	7.23	39	9.25	1.41	9.25	2.75	0.57
	2008	100.25	6	3.7	10.5	3.75	0.41	0.75	0.5	0.05
Fenwick	2006	83	16.25	4.37	17.75	8	0.52	5	3	0.26
	2007	35.75	8	1.51	1	0.75	0.02	0	0	0
	2008	12.5	7	0.43	0	0	0	0	0	0
Piscataway	2006	265.5	23	9.14	32.75	4.25	1.77	13.75	2.5	0.86
	2007	139.5	10.75	4.81	30	6.5	0.91	15.5	5.25	0.8
	2008	133.25	12.75	5.86	31.25	9	0.91	13.5	7.25	5.86