Initial Progress with the Patapsco-Back MTM and Applications

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Outline:

I. High-resolution modeling grid in Patapsco/Back River

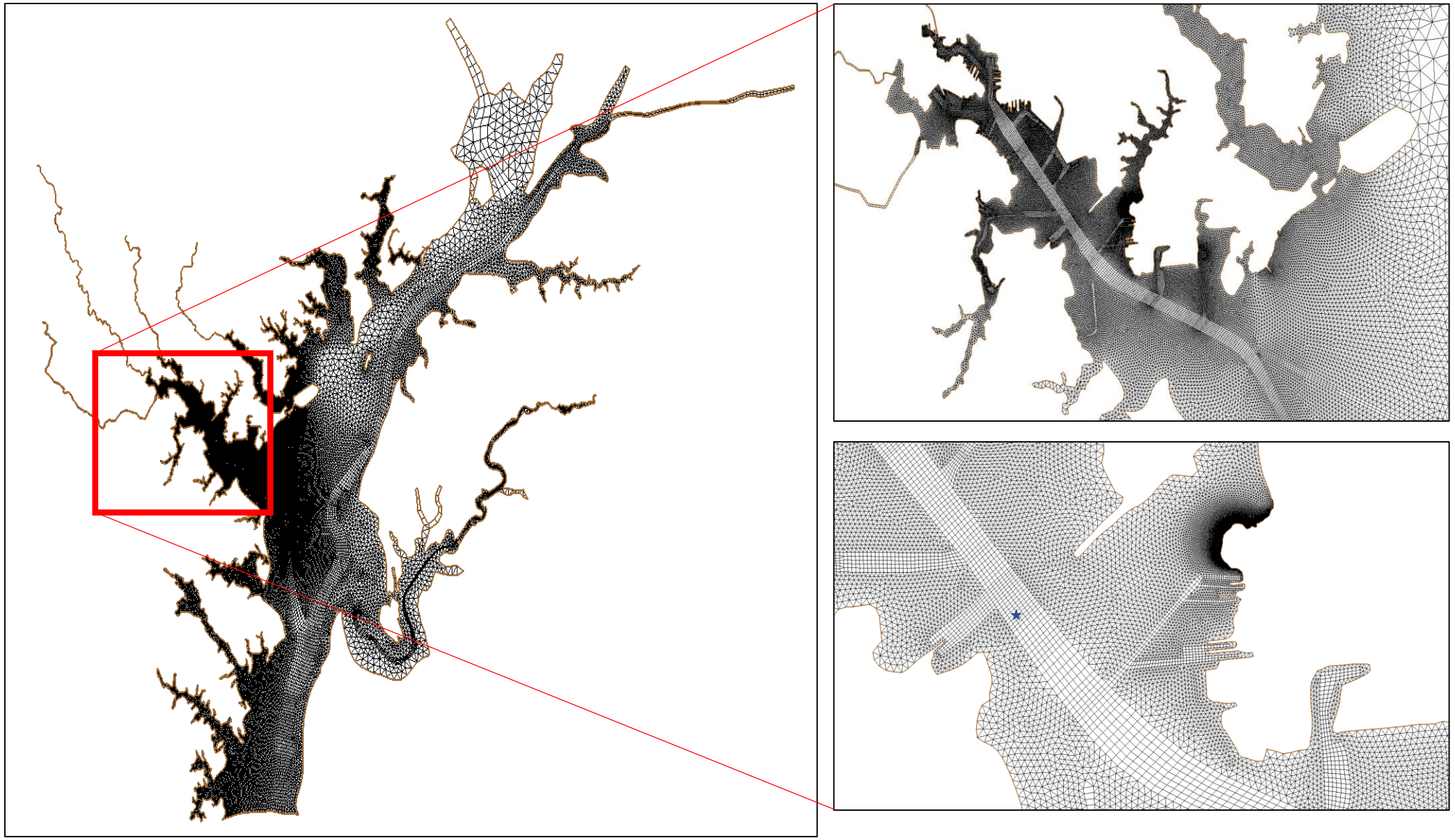
II. Preliminary calibration

III. Applications

IV. Discussion and conclusion

I. High-resolution modeling grid in Patapsco/Back River

(1) 3D SCHISM model domain



Overall resolution 50-100 m with a total of 61 k grid cells

Figure 1: The model domain to be used in evaluating near-field mixing and far-field dilution factors in (a) Upper Chesapeake Bay (b) Baltimore Harbor (c) Near Sparrow Point and Bear Creek. The resolution in the Beak Creek from the mouth to the headwater of Bear Creek is around 20 meters, sufficient for the particle tracking simulation

II. SCHISM hydrodynamic model calibration and validation

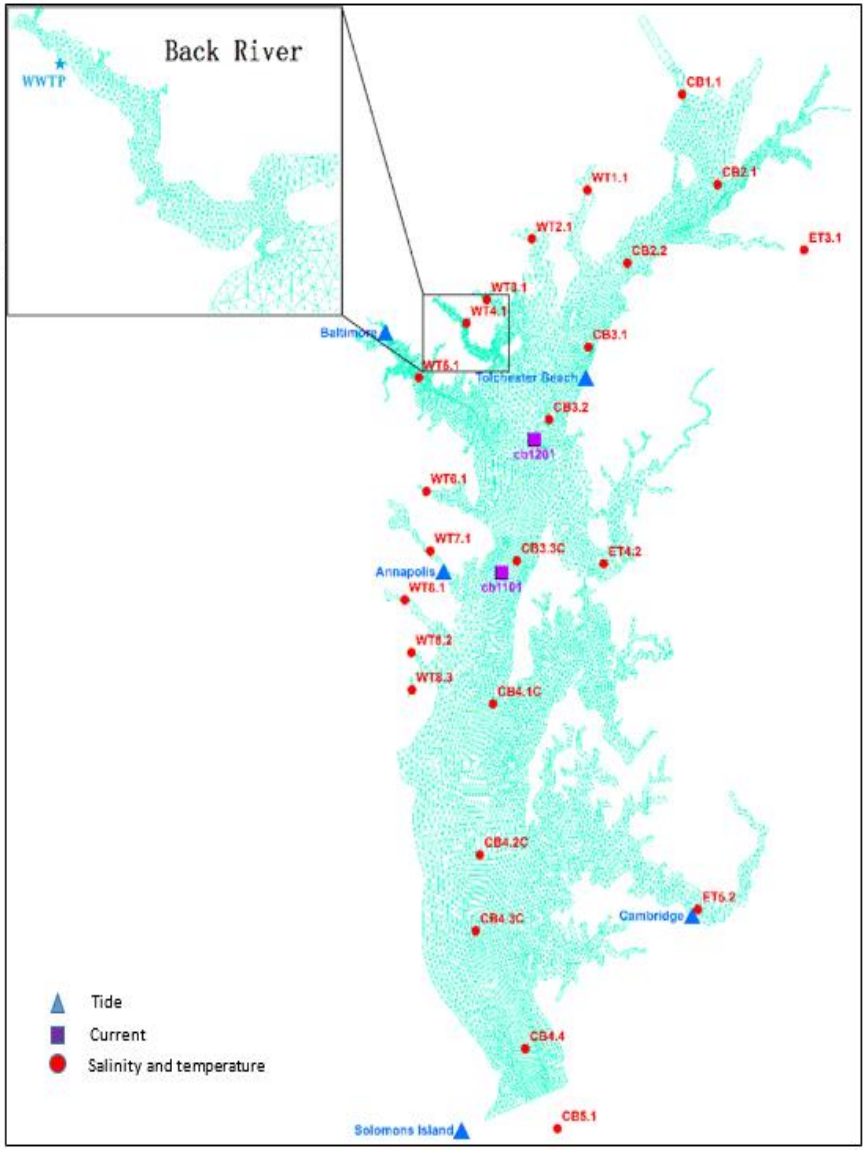
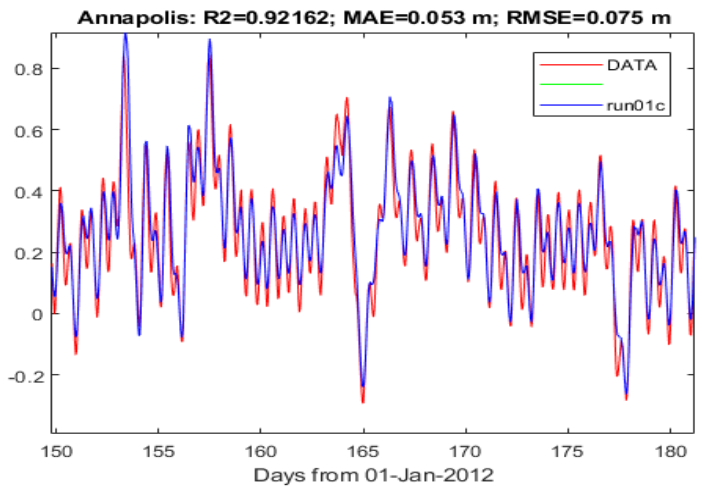
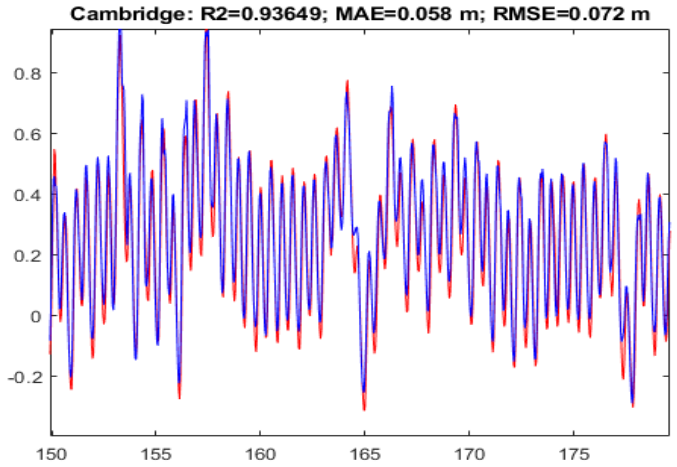
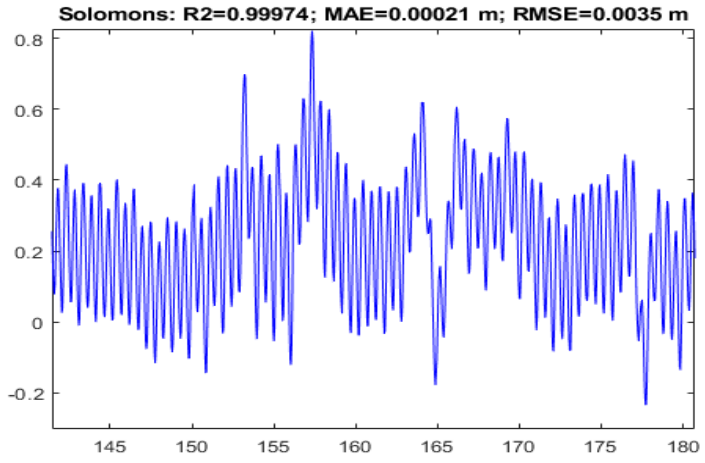


Figure 2: The Upper Bay SCHISM modeling grid with observation stations locations

Water Levels







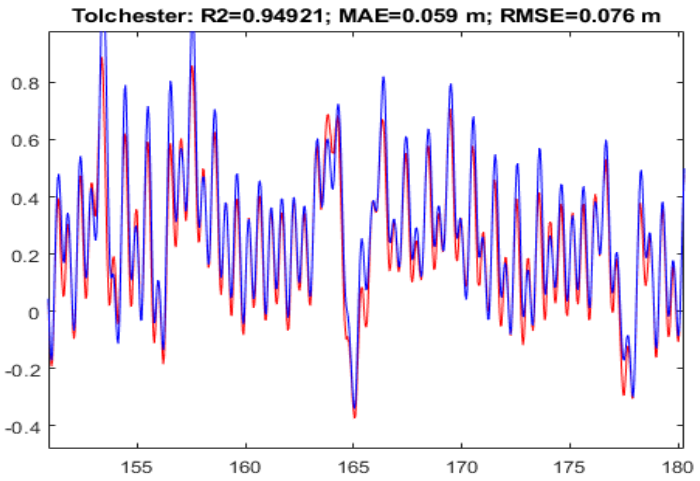
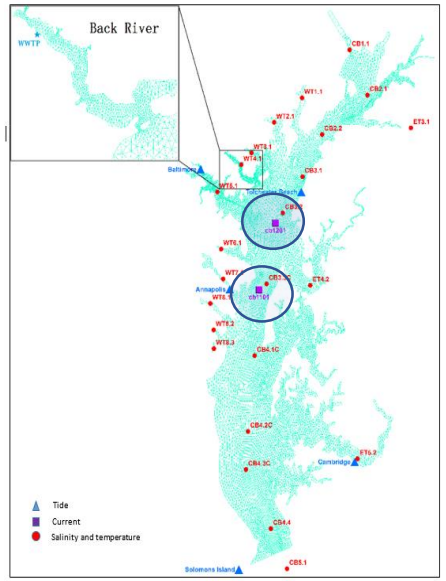
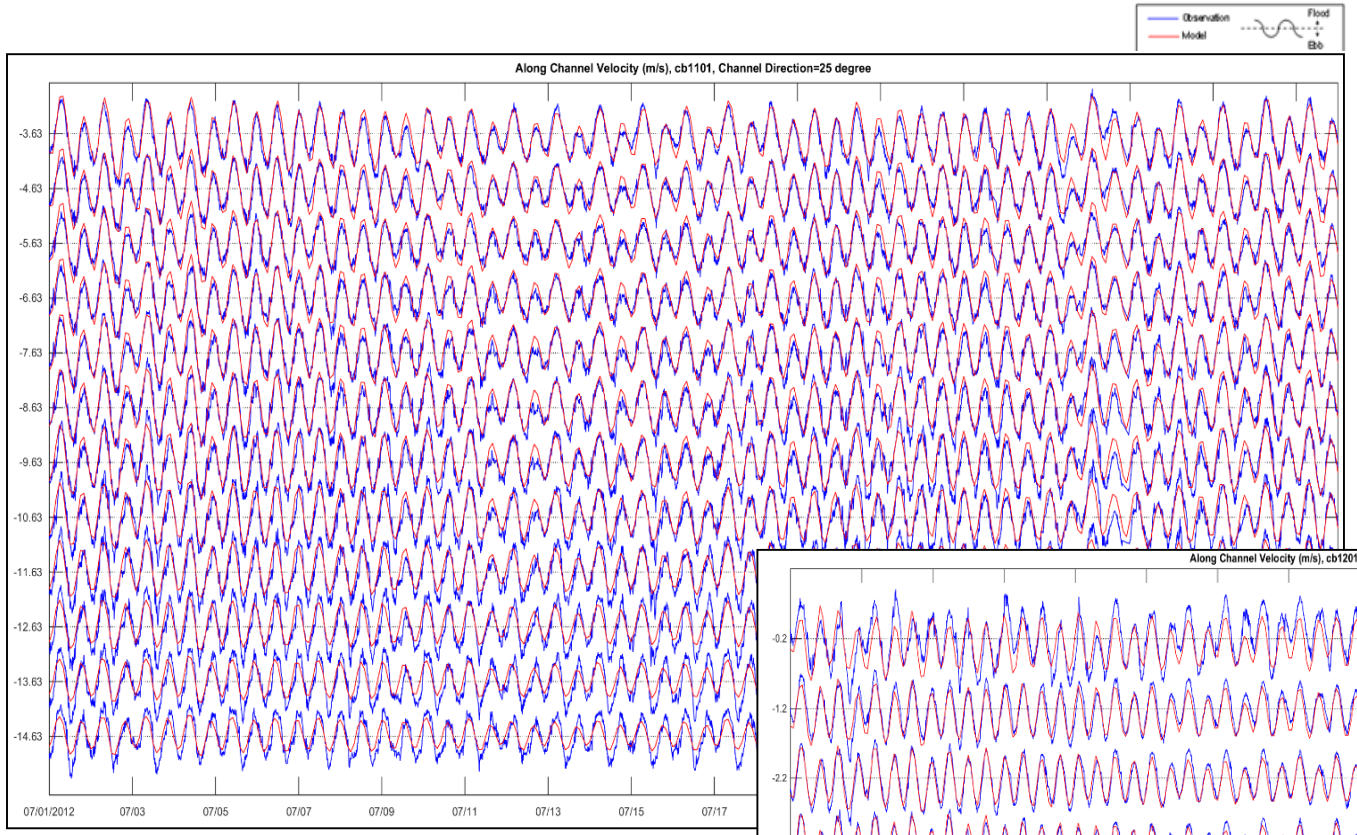


Figure 3: The modeled versus observed water elevation during June and July, 2012

Velocities





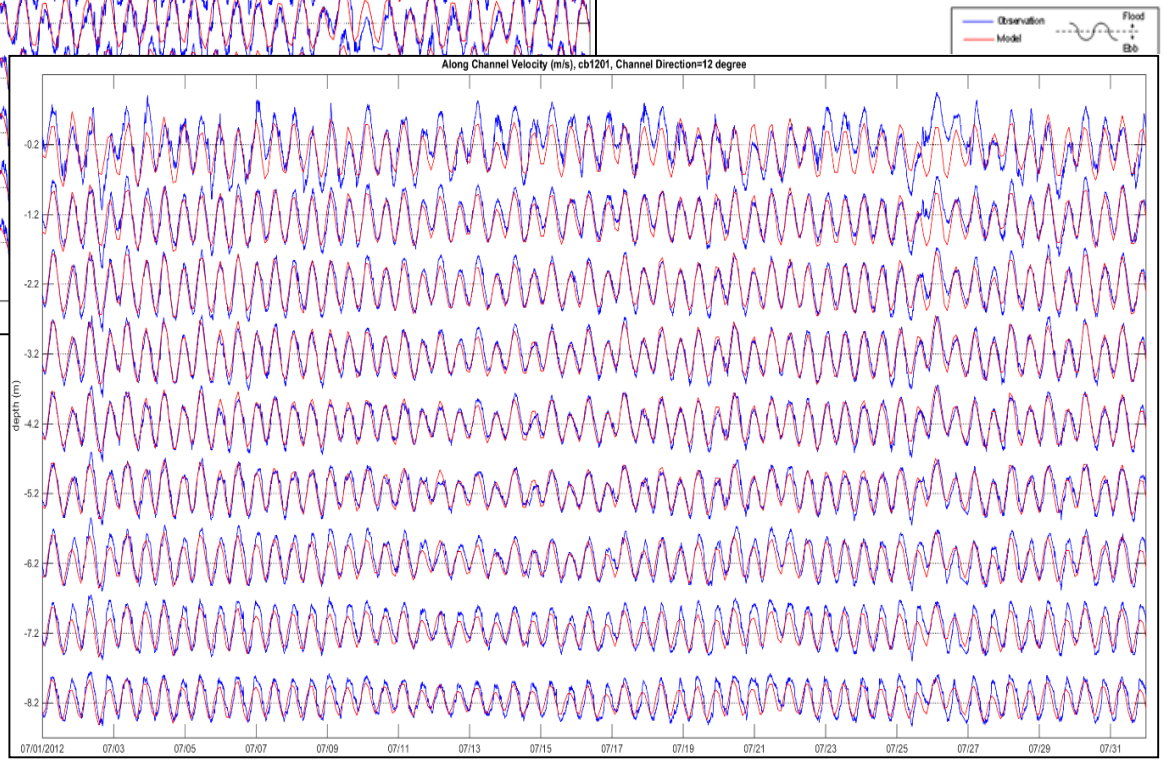


Figure 4: The modeled versus observed ADCP along channel current velocity during June and July, 2012 (top) at station cb1201 (bottom) at cb1101.

Temperatures

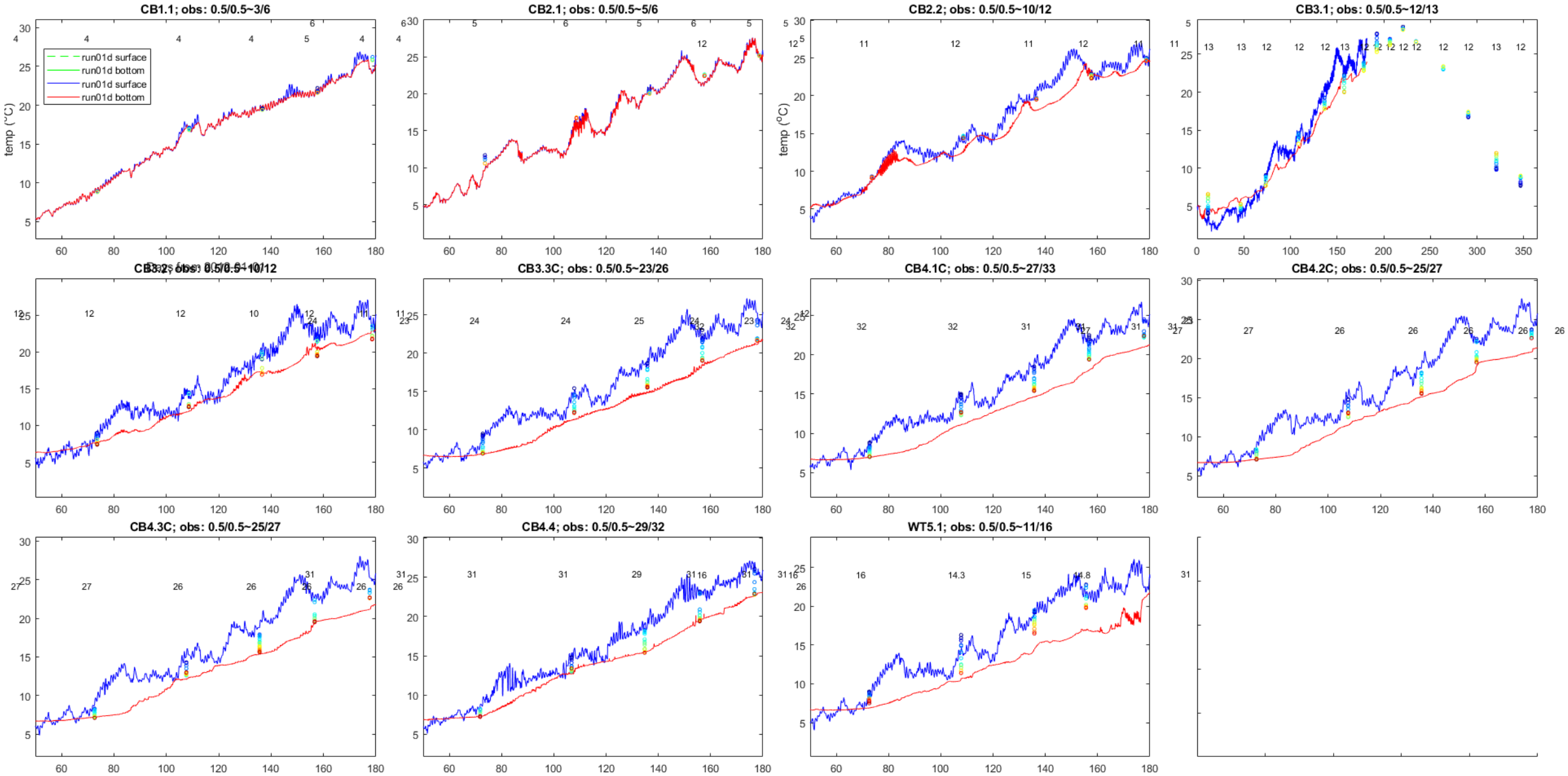


Figure 5: The modeled versus observed temperature in the Upper Bay during 2012

Salinities

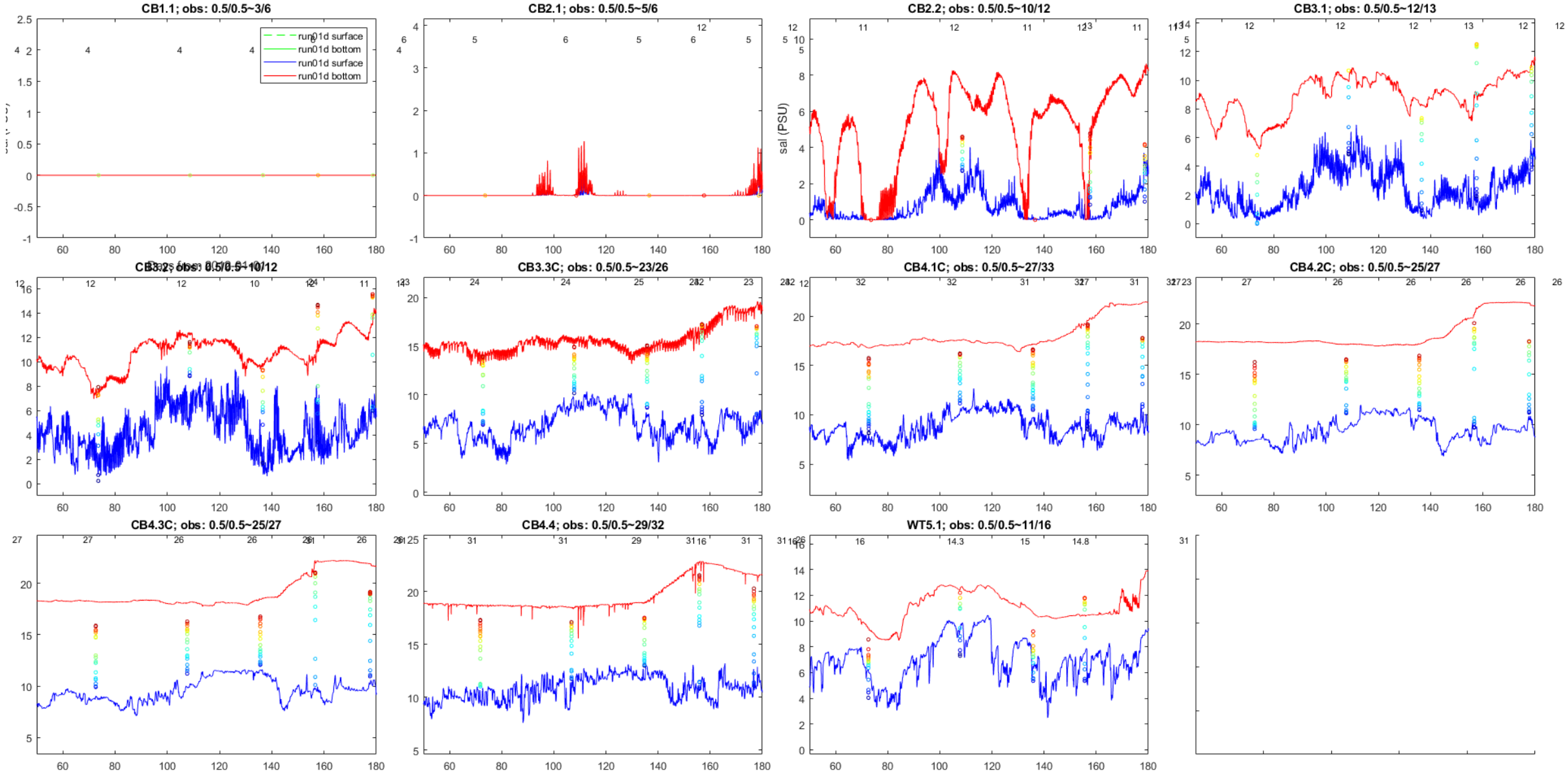
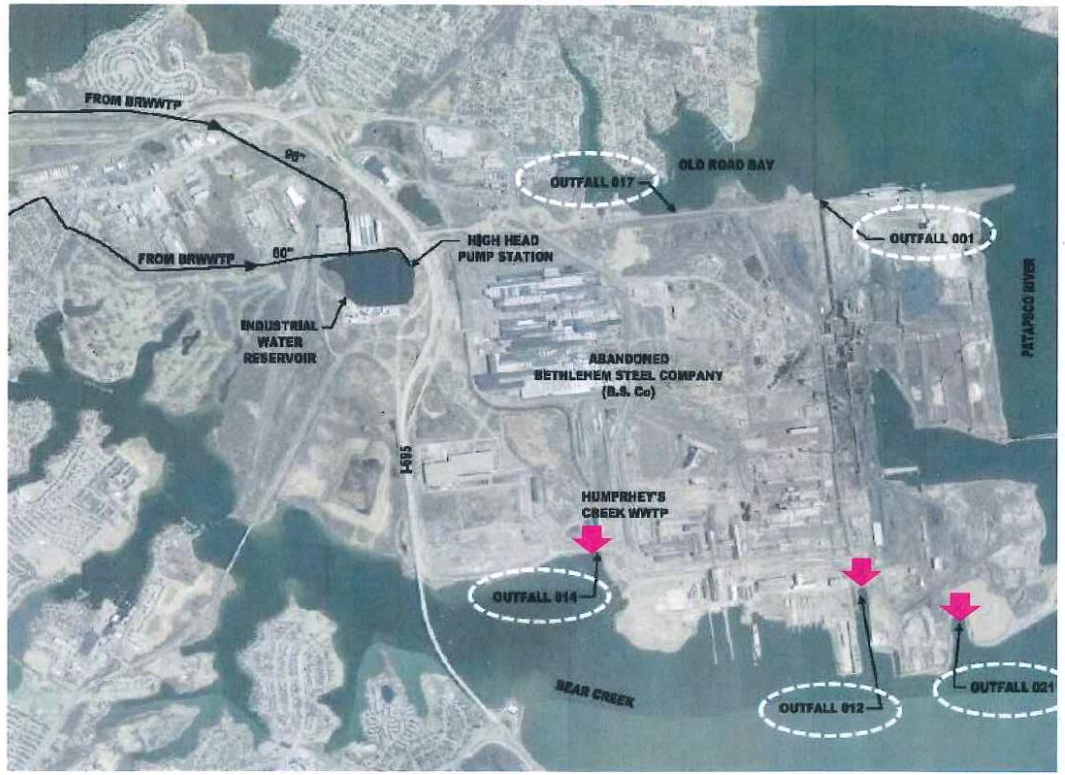


Figure 6: The modeled versus observed salinities in the Upper Bay during 2012

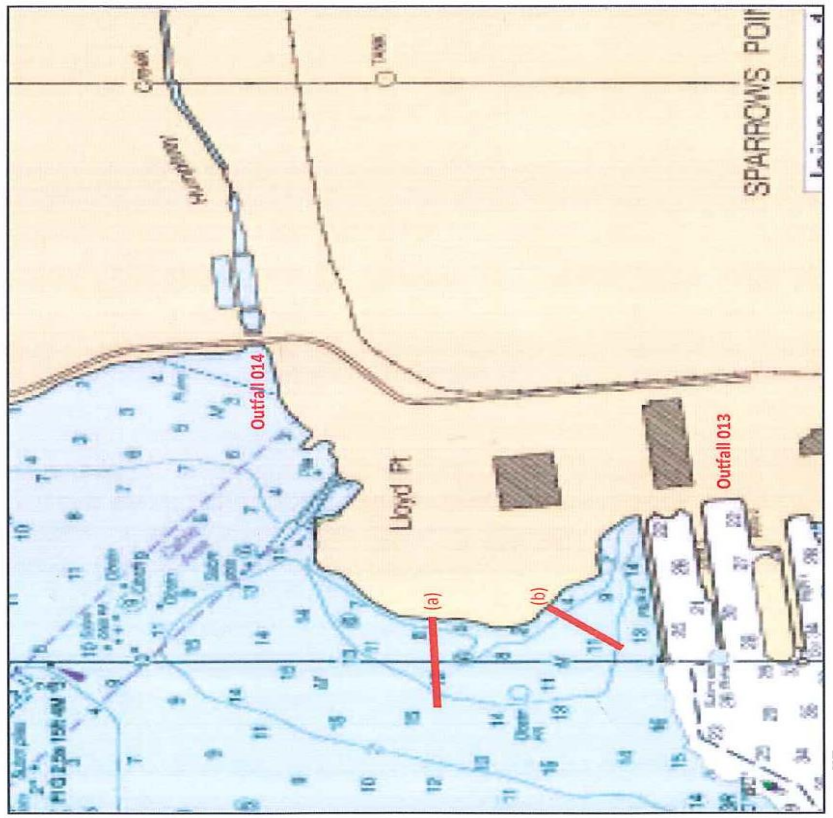
III. Applications - Bear Creek Proposed Effluent Outfall Evaluation

Existing outfall



001 (East)	0.864 mgd
012	50.0 mgd
014	26.0 mgd
017 (East)	2.8 mgd
021	8.6 mgd

Proposed new outfall (a) and (b)



IV. Results:

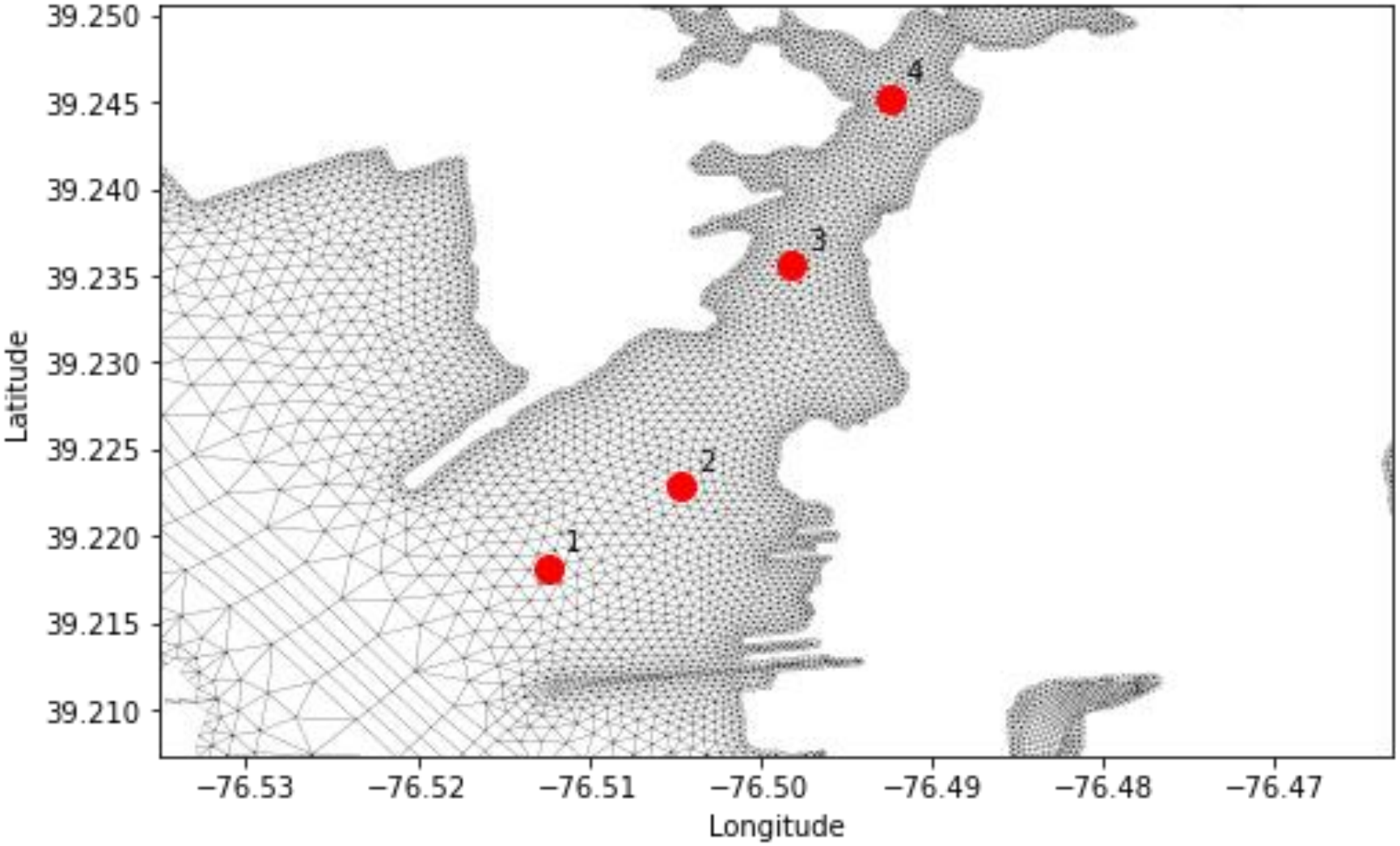
- Forced by Tide + Wind
- Compare nitrogen and phosphorus concentrations between Base Case & Scenario Runs

Presented by:

1. Spatial variability - particle tracking and concentration animation

2. Temporal variability - time series and statistical measures

- Sentinel station locations: record time series

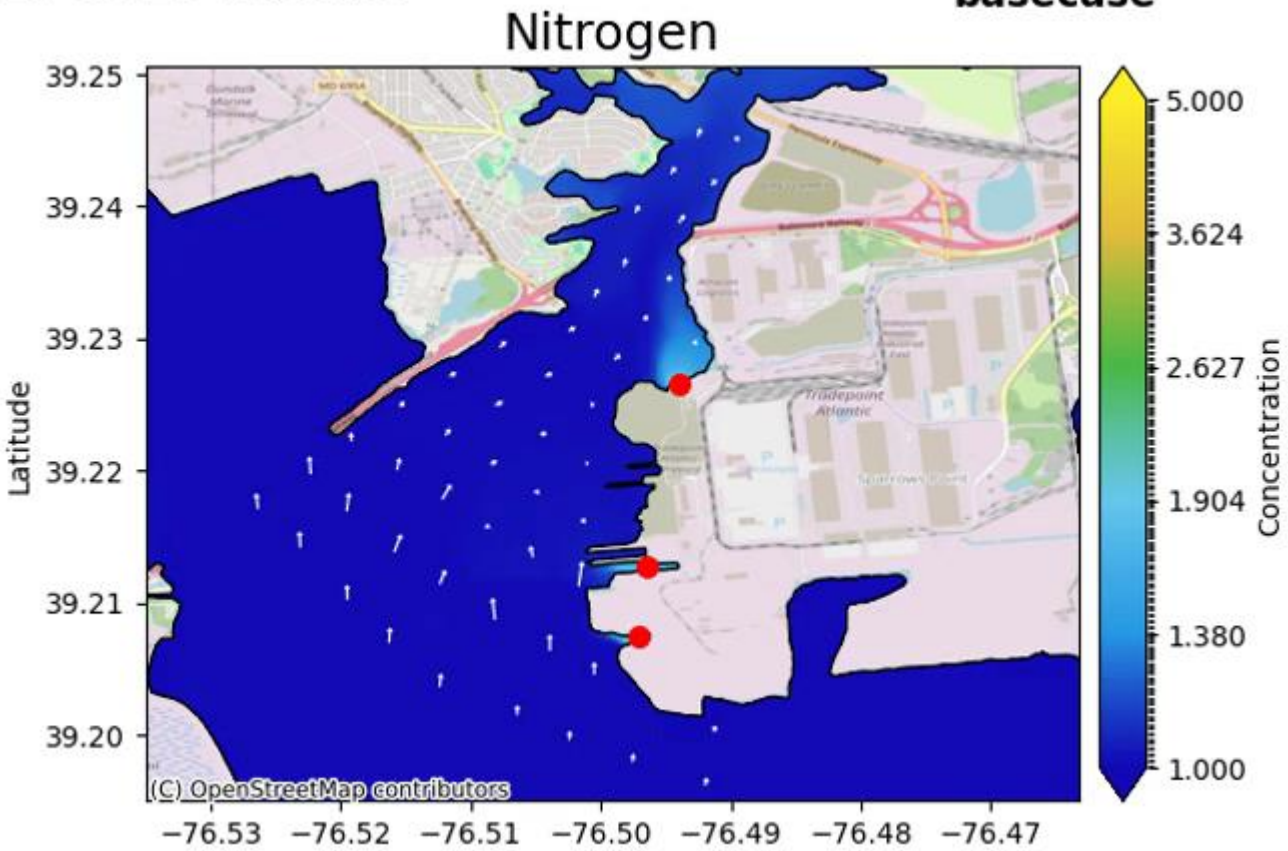


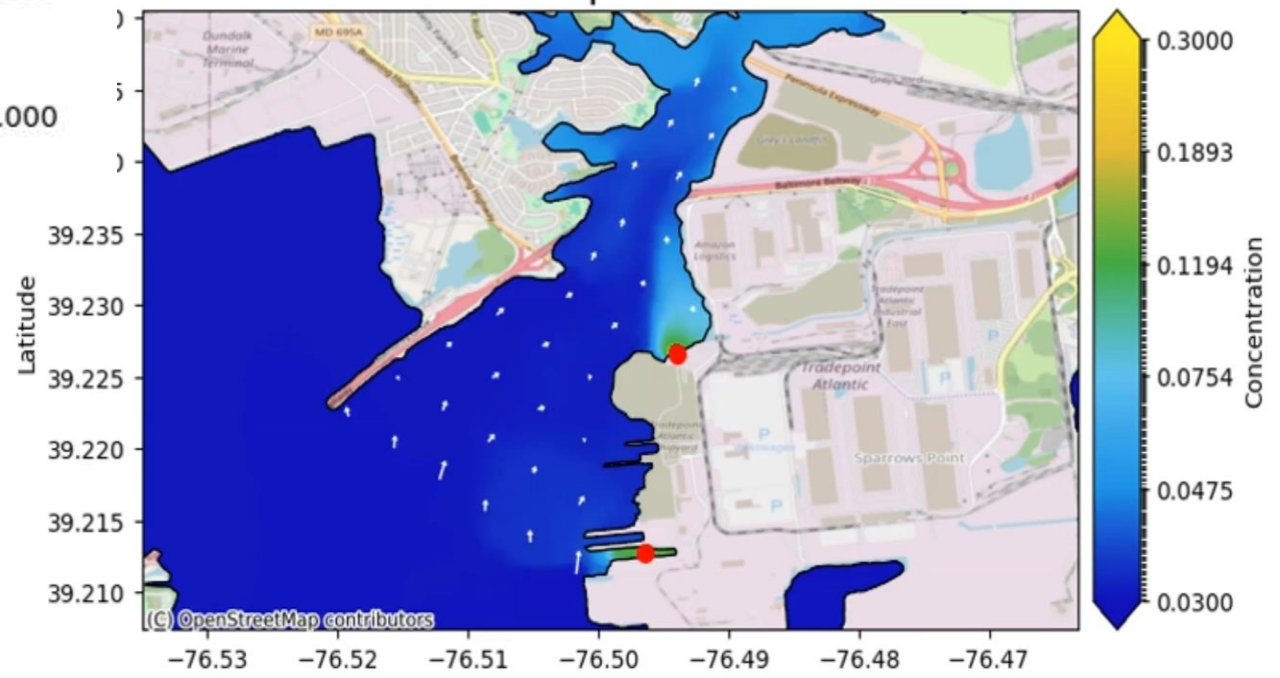
A. Base case

Species	**Nitrogen**				
	Outfalls and rate	**Concentration**	**Background condition**	**Boundary condition**	**Depth**
Base case	Outfall 014 = 26 mgd Outfall 012 = 50 mgd Outfall 021 = 8.6 mgd	4 mg/l 4 mg/l 4 mg/l	1 mg/l	0.99 mg/l	0.59 m 7.80 m 6.00 m
	Phosphorus				
Base case	Outfall 014 = 26 mgd Outfall 012 = 50 mgd Outfall 021 = 8.6 mgd	0.2 mg/l *0.5 mg/l 0.2 mg/l	0.03 mg/l	0.029 mg/l	0.59 m 7.80 m 6.00 m
*Based on MDE permit allocation (see slide 3)					

2012-05-16 01:00:00

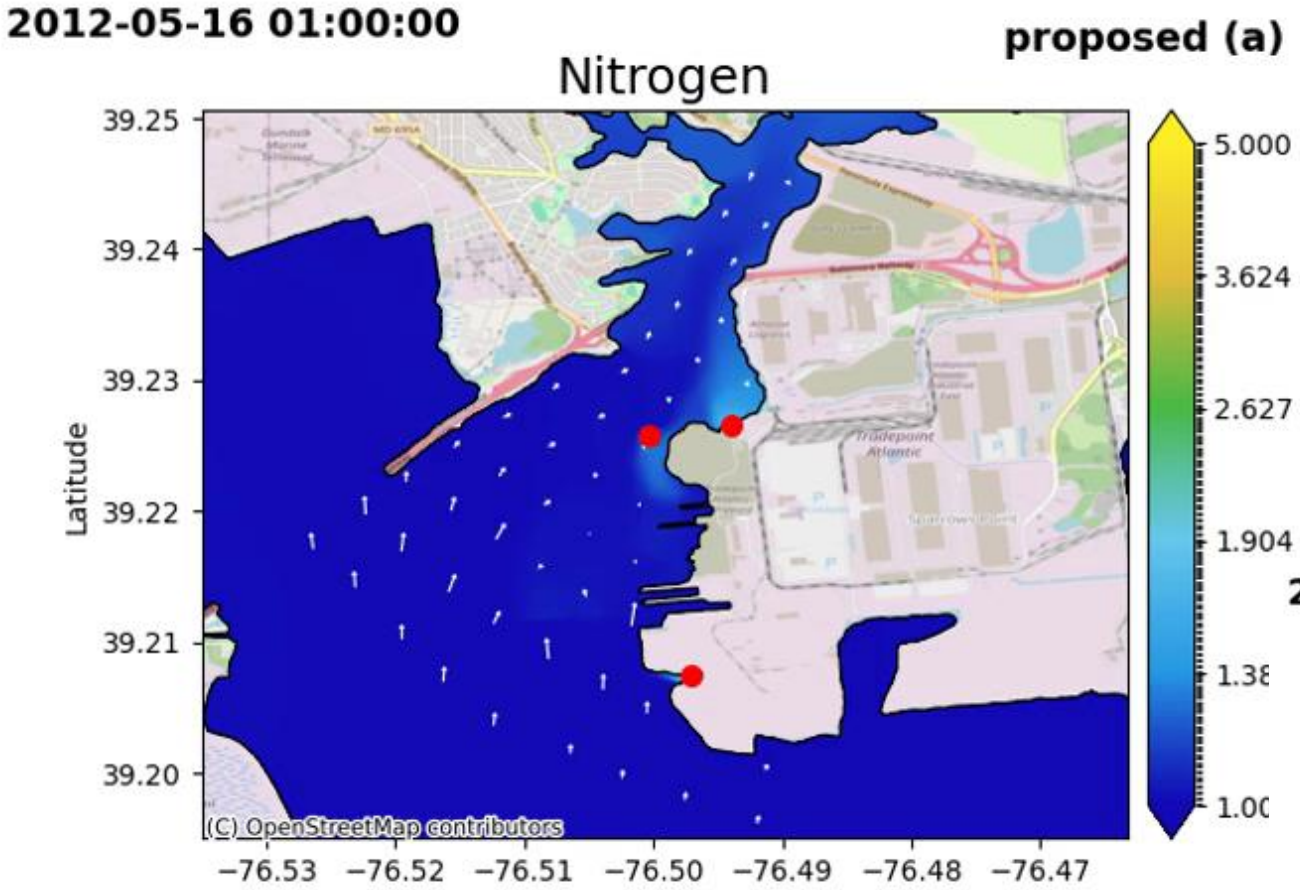
basecase





B. Scenario 10 Nitrogen and (Phosphorus)

Species	**Nitrogen**				
	Outfalls and rate	Concentration	Background condition	Boundary condition	Depth
Base case	Outfall 014 = 26 mgd Outfall 012 = 50 mgd Outfall 021 = 8.6 mgd	4 mg/l 4 mg/l 4 mg/l	1 mg/l	0.99 mg/l	0.59 m 7.80 m 6.00 m
Proposed a	Outfall 014 = 26 mgd Proposed outfall (a) = 50 mgd Outfall 021 = 8.6 mgd	4 mg/l *3 mg/l 4 mg/l	1 mg/l	0.99 mg/l	0.59 m 4.10 m 6.00 m
Proposed b	Outfall 014 = 26 mgd Proposed outfall (b) = 50 mgd Outfall 021 = 8.6 mgd	4 mg/l *3 mg/l 4 mg/l	1 mg/l	0.99mg/l	0.59 m 3.19 m 6.00 m
* 3 mg/l for the growing season from May-October and 4 mg/l in the non-growing season Nov, Dec, Jan, Feb, March, and April					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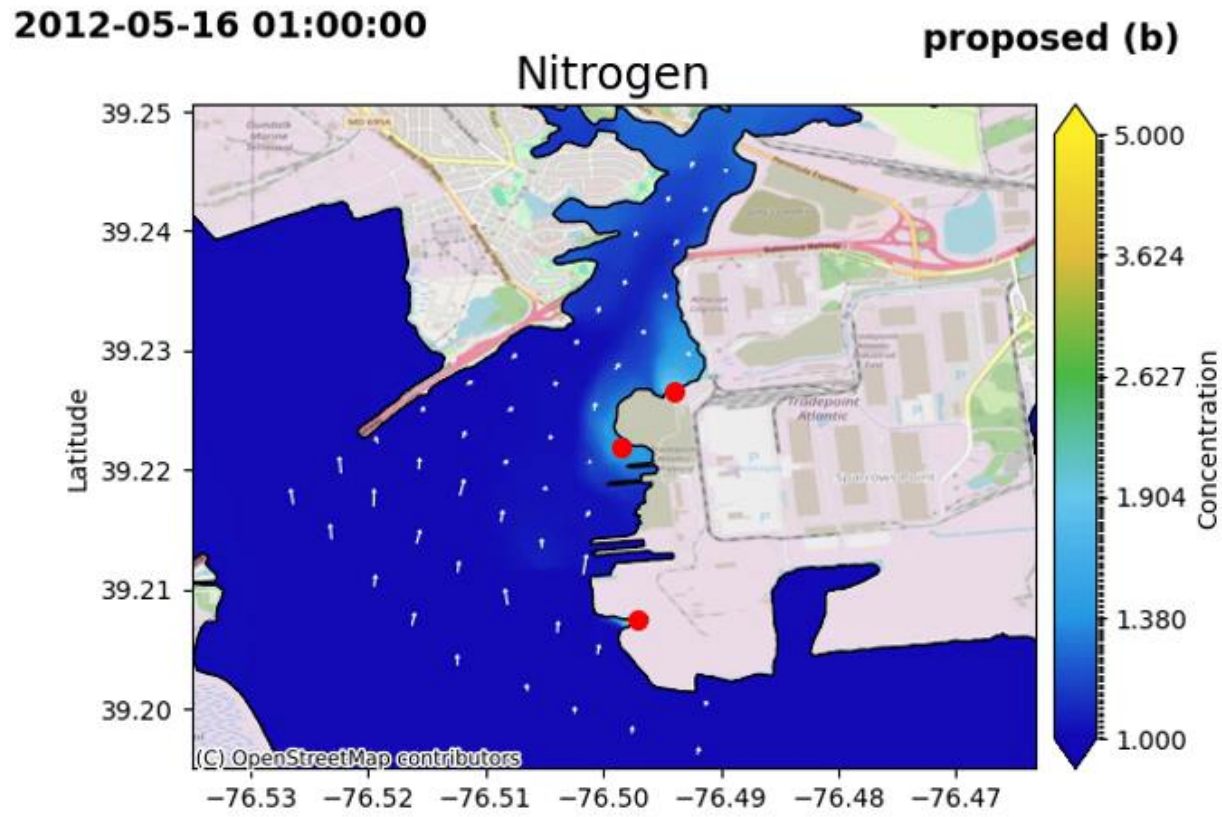
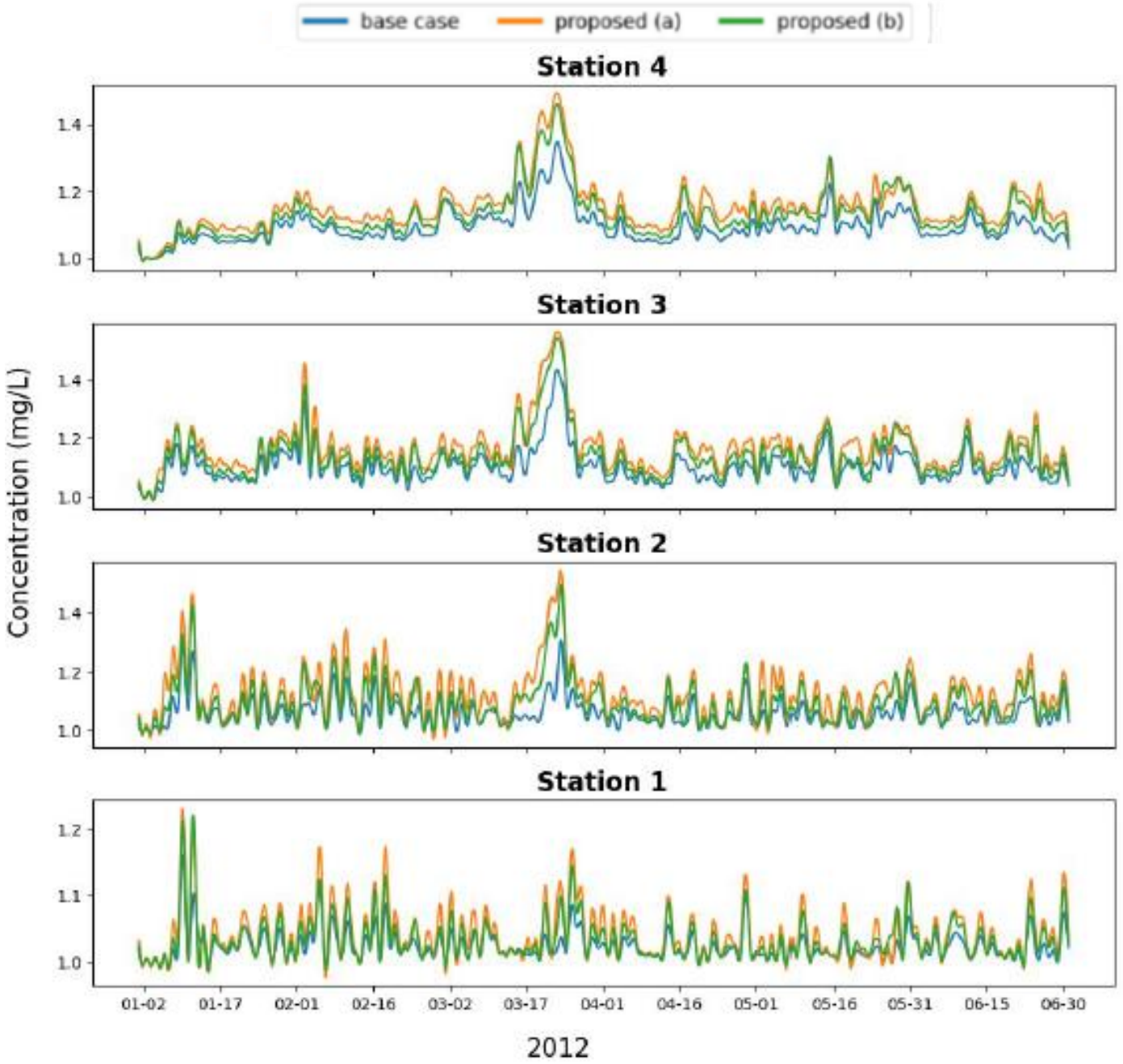
proposed (a)
Nitrogen
Latitude
39.25
39.24
39.23
39.22
39.21
39.20
−76.53
−76.52
−76.51
−76.50
−76.49
−76.48
−76.47
(C) OpenStreetMap contributors
5.000
3.624
2.627
1.904
1.38
1.00
oncentration


2012-05-16 01:00:00
proposed (b)
Nitrogen
Latitude
39.25
39.24
39.23
39.22
39.21
39.20
−76.53
−76.52
−76.51
−76.50
−76.49
−76.48
−76.47
(C) OpenStreetMap contributors
5.000
3.624
2.627
1.904
1.380
1.000
Concentration

Nitrogen : Lowpass Results: (left) time series (right) statistical measures



Mean			
station	base	Proposed a	Proposed b
4	1.096	1.154	1.131
3	1.103	1.167	1.140
2	1.061	1.127	1.096
1	1.025	1.042	1.034

st dev			
station	base	scenario01	scenario02
4	0.050	0.074	0.071
3	0.060	0.084	0.080
2	0.046	0.086	0.073
1	0.021	0.037	0.031

max			
station	base	Scenario01	scenario02
4	1.348	1.493	1.461
3	1.436	1.566	1.546
2	1.308	1.545	1.496
1	1.162	1.230	1.220

Min			
station	base	scenario01	scenario02
4	0.995	0.991	0.993
3	0.992	0.987	0.987
2	0.990	0.971	0.989
1	0.991	0.977	0.987

Con't Scenario 10: Phosphorus

Species	**Phosphorus**				
	Outfalls and rate	**Concentration**	**Background condition**	**Boundary condition**	**Depth**
Base case	Outfall 014 = 26 mgd Outfall 012 = 50 mgd Outfall 021 = 8.6 mgd	0.2 mg/l 0.5 mg/l 0.2 mg/l	0.03 mg/l	0.029 mg/l	0.59 m 7.80 m 6.00 m
Proposed (a)	Outfall 014 = 26 mgd Proposed outfall (a) = 50 mgd Outfall 021 = 8.6 mgd	0.2 mg/l 0.2 mg/l 0.2 mg/l	0.03 mg/l	0.029 mg/l	0.59 m 4.10 m 6.00 m
Proposed (b)	Outfall 014 = 16 mgd Proposed outfall (b) = 50 mgd Outfall 021 =8.6 mgd	0.2 mg/l 0.2 mg/l 0.2 mg/l	0.03 mg/l	0.029 mg/l	0.59 m 3.19 m 6.00 m

Summary:

1. The Patapsco-Back MTM fine-resolution modeling grid has been completed as part of the MTM Upper Chesapeake Bay model. The overall resolution ranges from 50 – 100 m with total number of grid cells close to 61k grid cells.

2. The model was preliminarily calibrated and verified for January 2012 – June 30 2012 with very reasonable skill on water level, velocity, salinity and temperature.

3. The model was being applied for Bear Creek proposed effluent outfall evaluation and is being configured to assist recent bridge collapse incident in Baltimore Harbor.