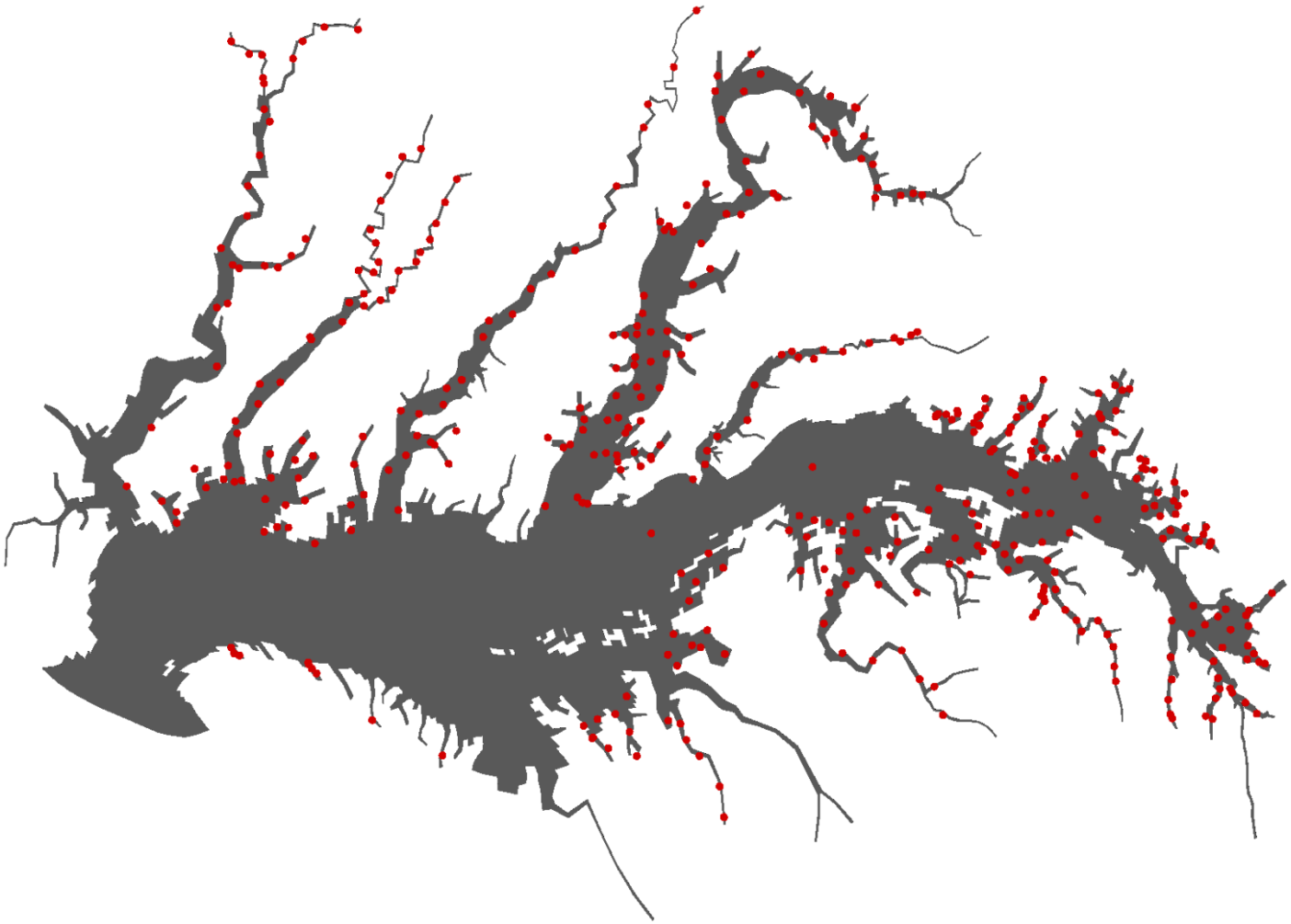
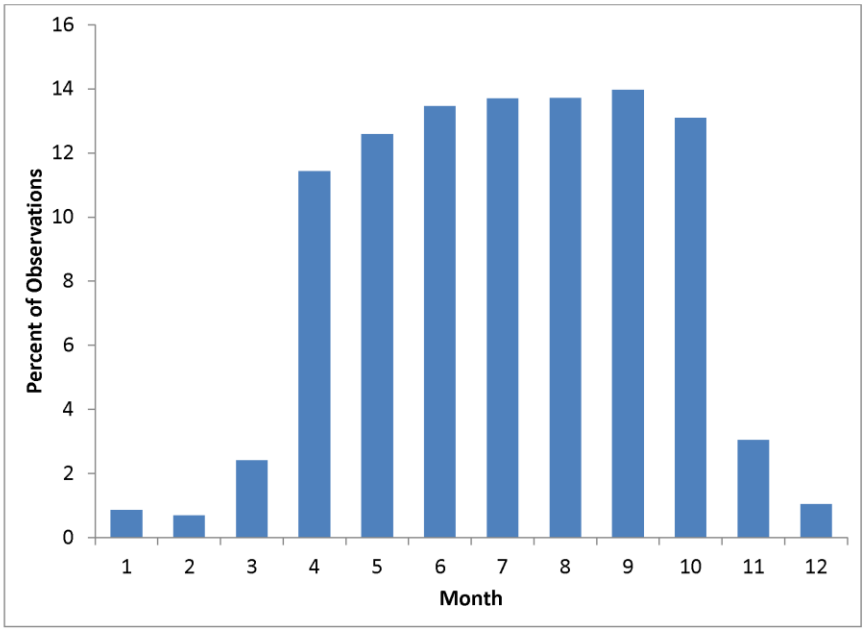
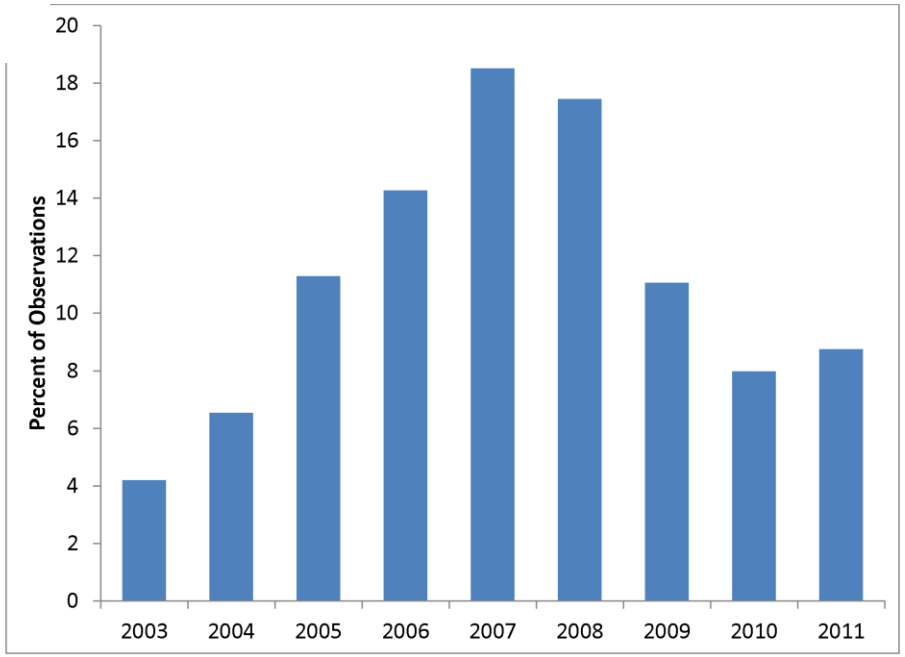
WQSTM Shallow-Water Simulation

- We received the shallow-water database from CBP circa autumn 2012.
- These are grab samples and measures collected when continuous stations are serviced and coincident with Dataflow cruises.
- More than 750,000 records.
- Roughly 84,000 useful observations.



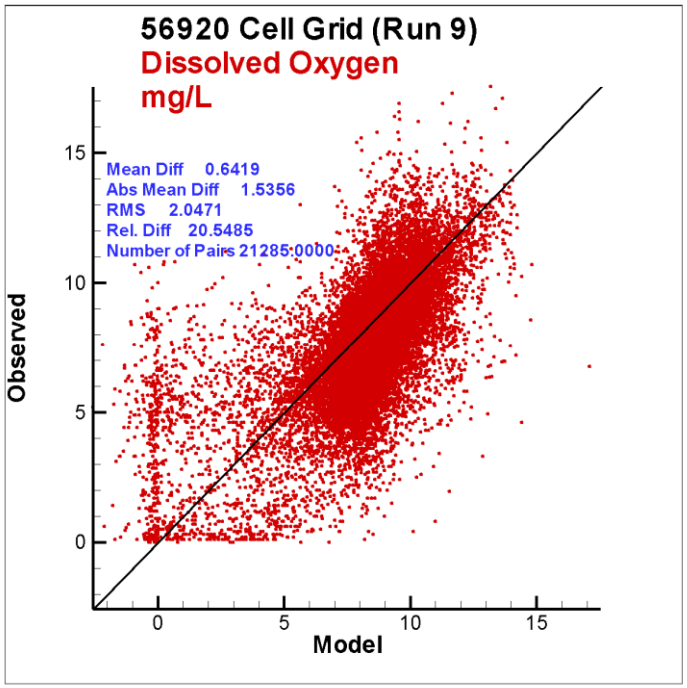


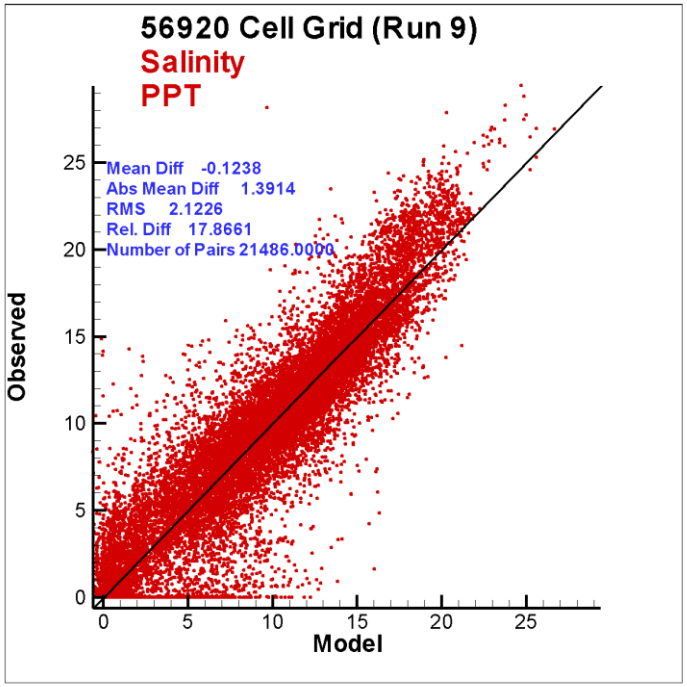
- Observations are evenly distributed from April to October.
- Peak sampling 2006 – 2008.
- We need a model from 2003 to 2011 to encompass these observations.

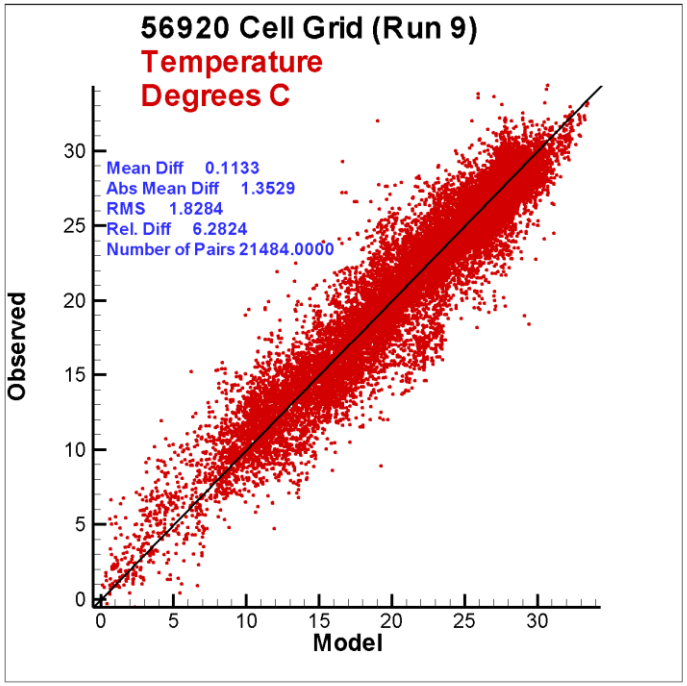


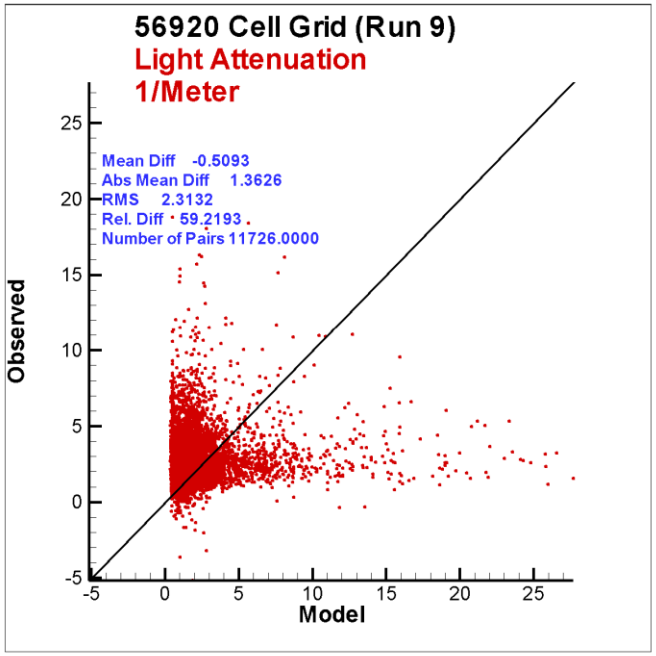
WQSTM Shallow-Water Simulation

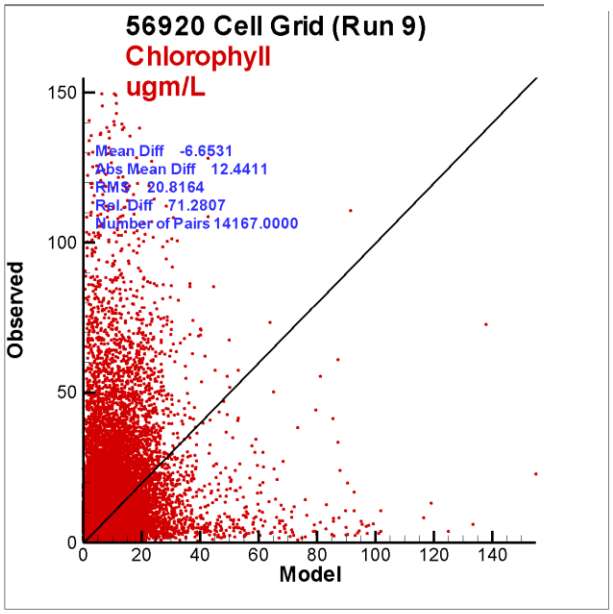
- We are now running 2002 – 2011 as our calibration and development focus.
- Three graphical examinations of performance in shallow water:
  - Scatter plots of computed vs observed.
  - Cumulative distribution plots of computed and observed.
  - Comparisons to performance in deep water.

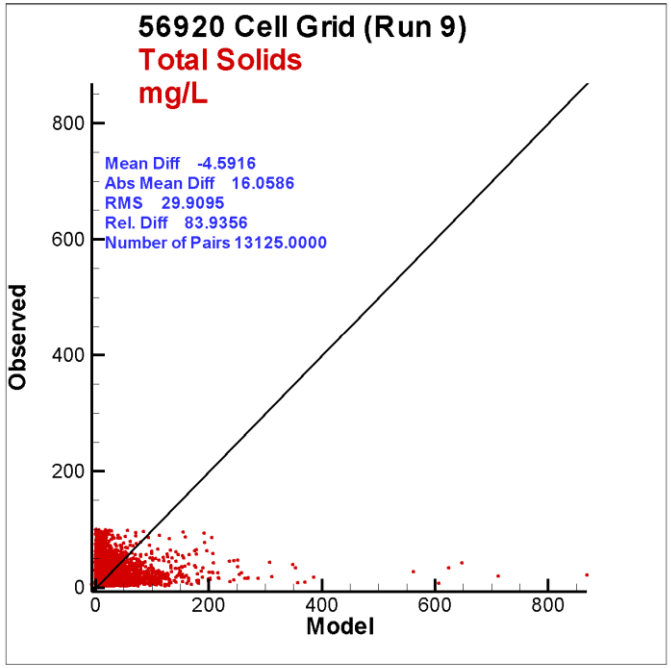

56920 Cell Grid (Run 9)
Dissolved Oxygen
mg/L
Mean Diff 0.6419
Abs Mean Diff 1.5356
RMS 2.0471
Rel. Diff 20.5485
Number of Pairs 21285.0000
Observed
Model
0
5
10
15

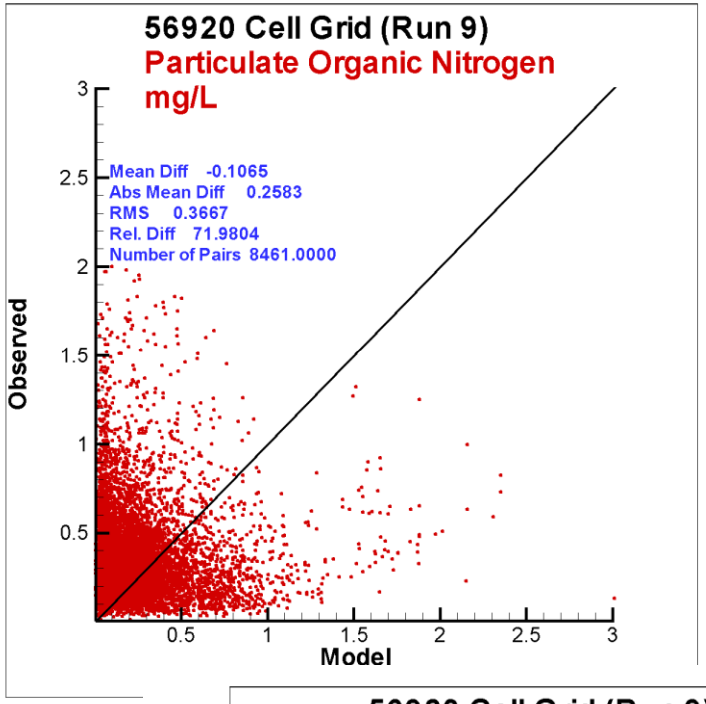

56920 Cell Grid (Run 9)
Salinity
PPT
Mean Diff -0.1238
Abs Mean Diff 1.3914
RMS 2.1226
Rel. Diff 17.8661
Number of Pairs 21486.0000
Observed
Model
0
5
10
15
20
25

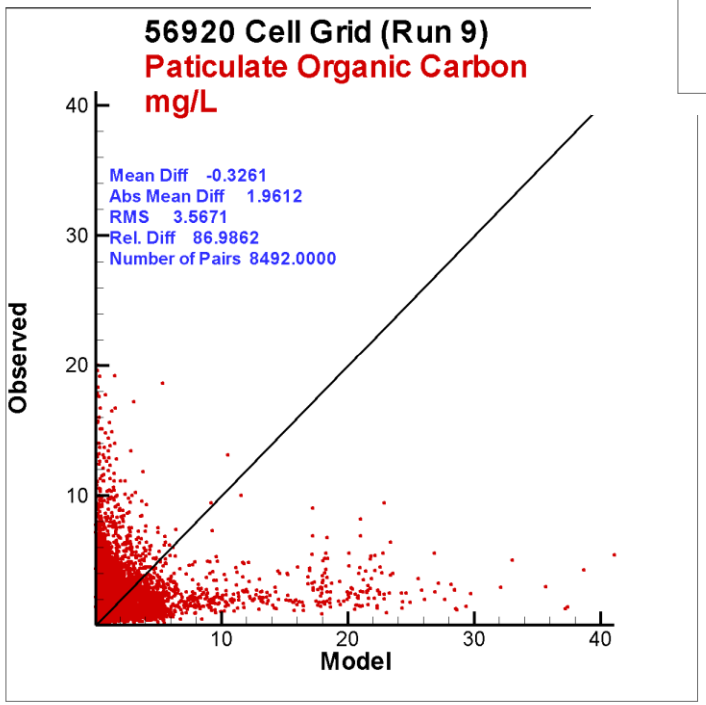

56920 Cell Grid (Run 9)
Temperature
Degrees C
Mean Diff 0.1133
Abs Mean Diff 1.3529
RMS 1.8284
Rel. Diff 6.2824
Number of Pairs 21484.0000
Observed
Model
0
5
10
15
20
25
30

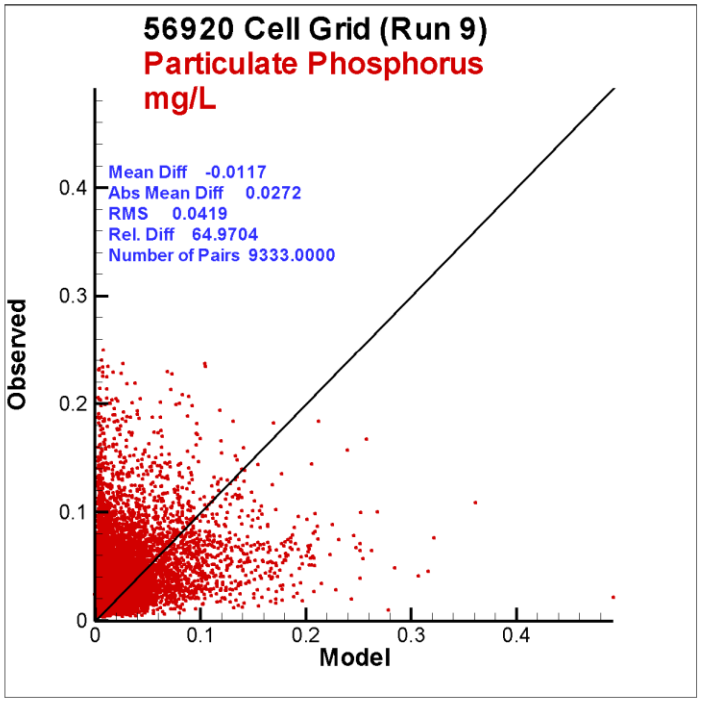

56920 Cell Grid (Run 9)
Light Attenuation
1/Meter
Mean Diff -0.5093
Abs Mean Diff 1.3626
RMS 2.3132
Rel. Diff 59.2193
Number of Pairs 11726.0000
Observed
Model
25
20
15
10
5
0
-5
-5
0
5
10
15
20
25


56920 Cell Grid (Run 9)
Chlorophyll
ugm/L
Mean Diff -6.6531
Abs Mean Diff 12.4411
RMS 20.8164
Rel. Diff 71.2807
Number of Pairs 14167.0000
Observed
Model
150
100
50
0
0
20
40
60
80
100
120
140

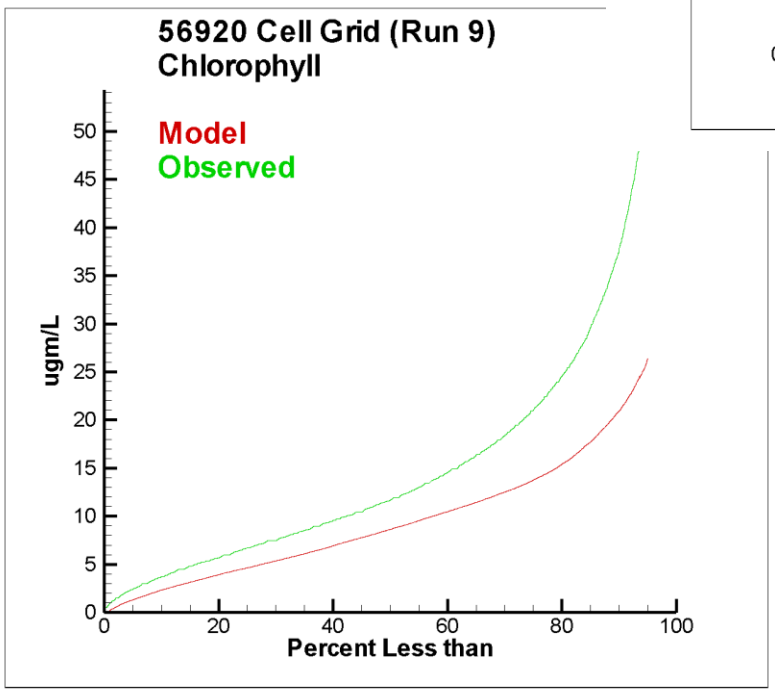

56920 Cell Grid (Run 9)
Total Solids
mg/L
Mean Diff -4.5916
Abs Mean Diff 16.0586
RMS 29.9095
Rel. Diff 83.9356
Number of Pairs 13125.0000
Observed
Model
800
600
400
200
0
0
200
400
600
800

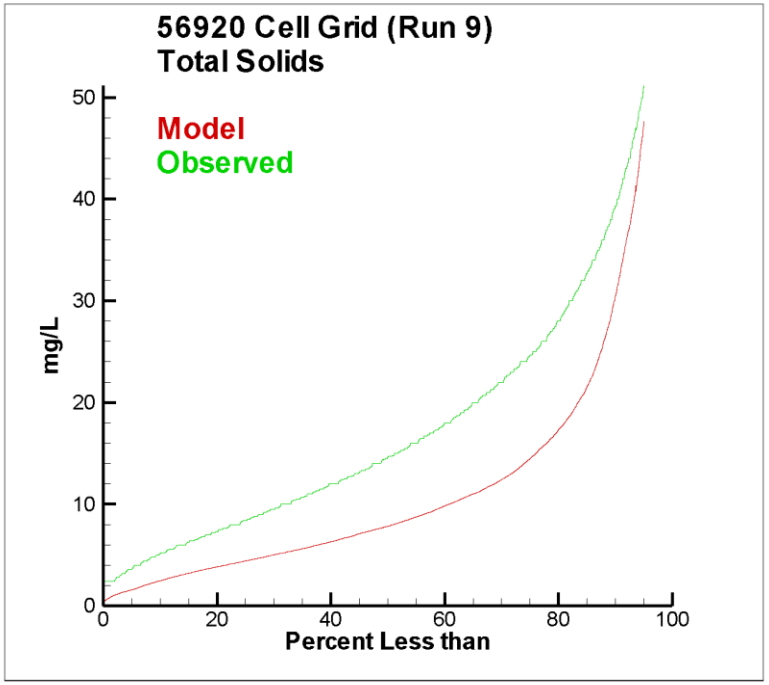

56920 Cell Grid (Run 9)
Particulate Organic Nitrogen
mg/L
Mean Diff -0.1065
Abs Mean Diff 0.2583
RMS 0.3667
Rel. Diff 71.9804
Number of Pairs 8461.0000
Observed
Model
0.5
1
1.5
2
2.5
3

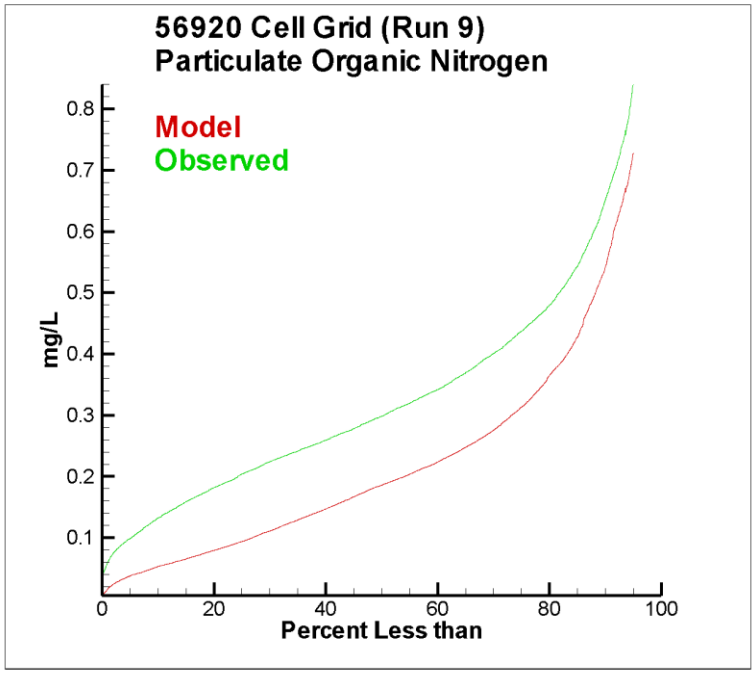

56920 Cell Grid (Run 9)
Paticulate Organic Carbon
mg/L
Mean Diff -0.3261
Abs Mean Diff 1.9612
RMS 3.5671
Rel. Diff 86.9862
Number of Pairs 8492.0000
Observed
Model
10
20
30
40

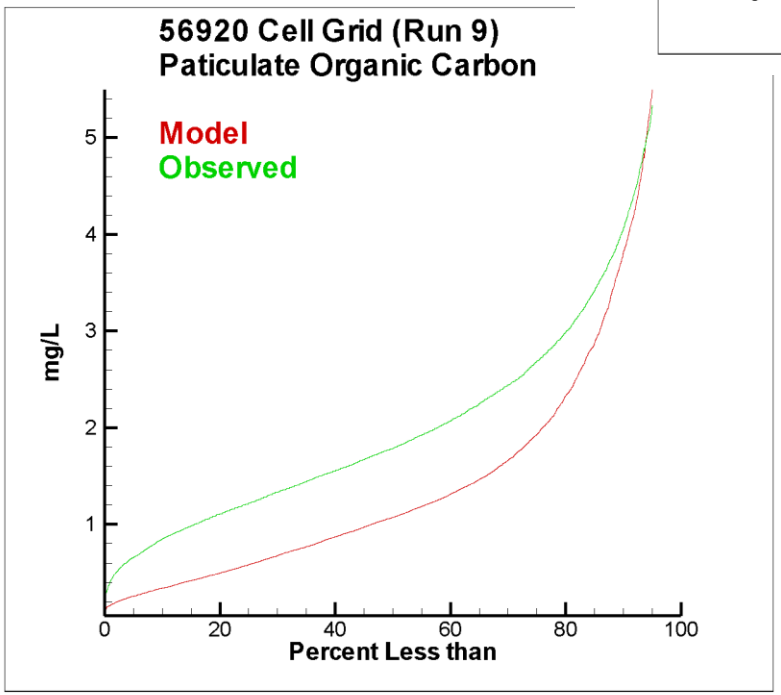

56920 Cell Grid (Run 9)
Particulate Phosphorus
mg/L
Mean Diff -0.0117
Abs Mean Diff 0.0272
RMS 0.0419
Rel. Diff 64.9704
Number of Pairs 9333.0000
Observed
Model
0
0.1
0.2
0.3
0.4

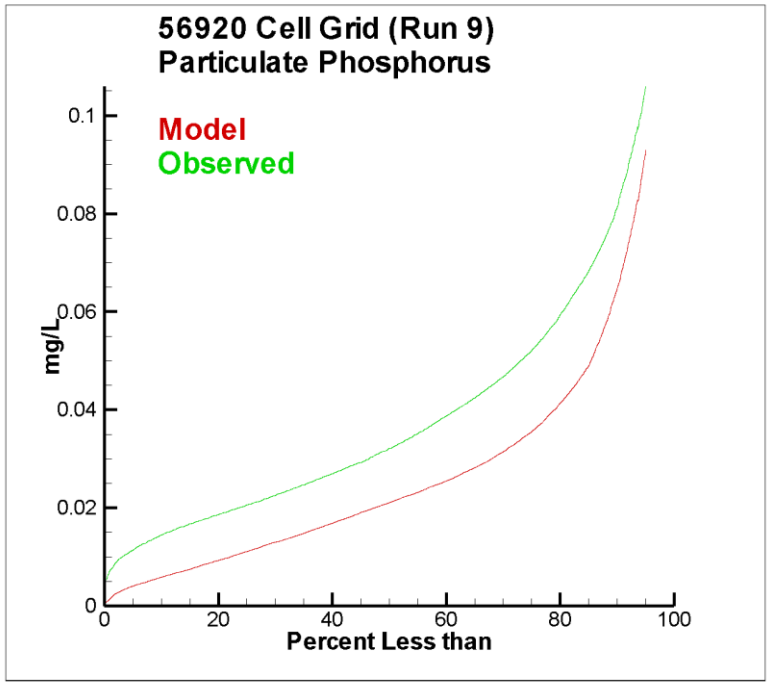
56920 Cell Grid (Run 9)
Light Attenuation
Model
Observed
1/Meter
0
1
2
3
4
0
20
40
60
80
100
Percent Less than

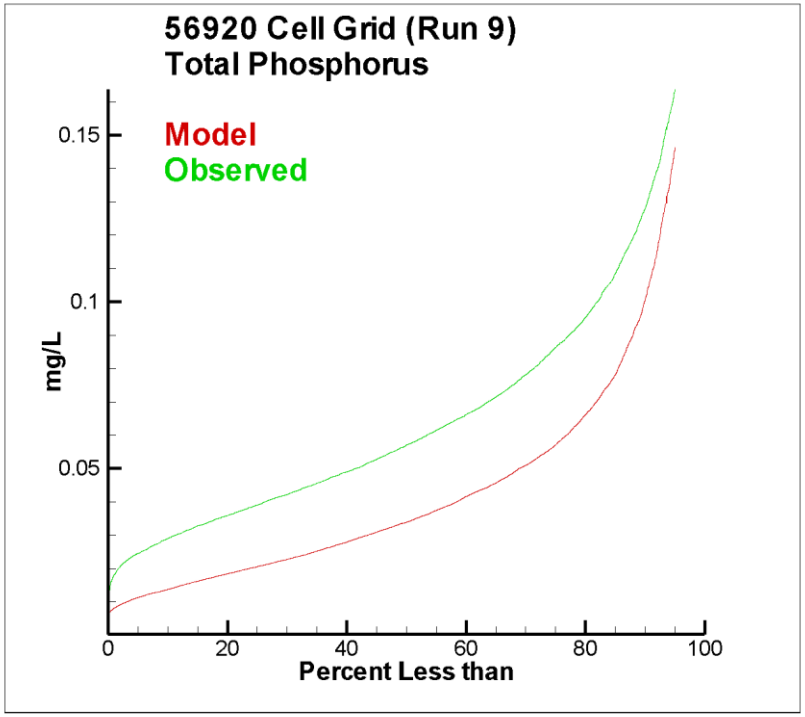

56920 Cell Grid (Run 9)
Chlorophyll
Model
Observed
ugm/L
0
5
10
15
20
25
30
35
40
45
50
0
20
40
60
80
100
Percent Less than

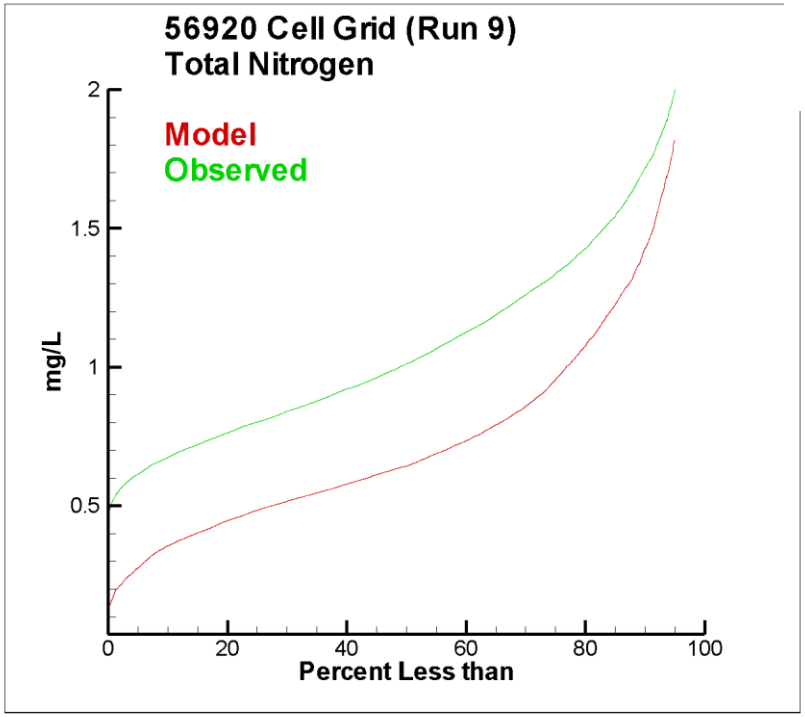

56920 Cell Grid (Run 9)
Total Solids
Model
Observed
mg/L
0
10
20
30
40
50
0
20
40
60
80
100
Percent Less than

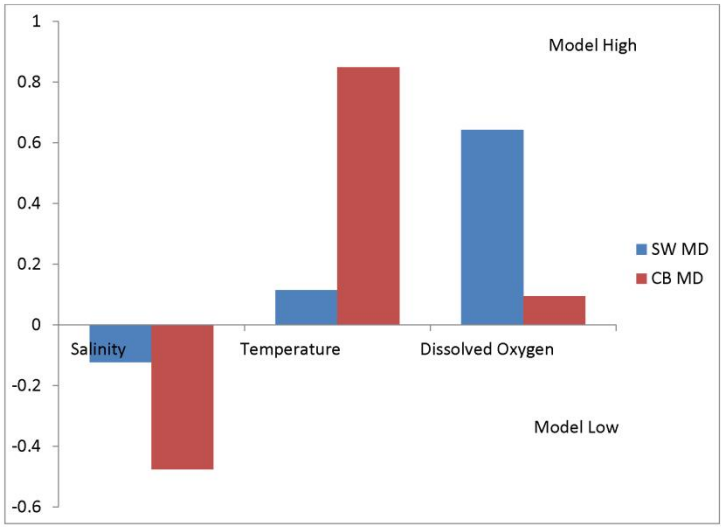

56920 Cell Grid (Run 9)
Particulate Organic Nitrogen
Model
Observed
mg/L
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
20
40
60
80
100
Percent Less than

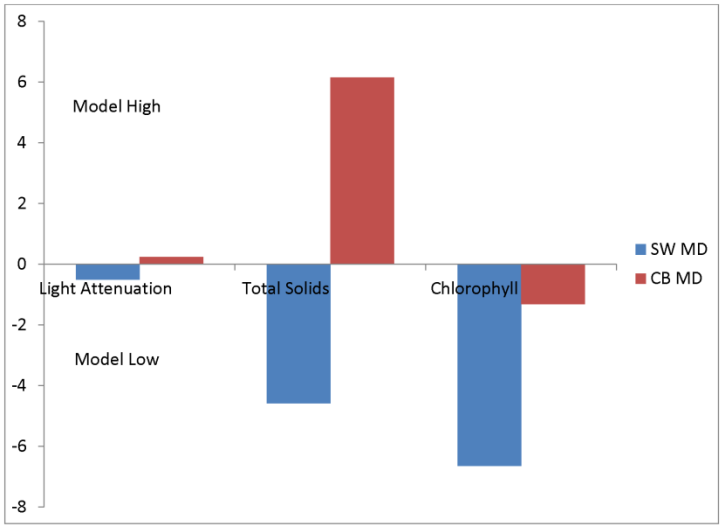

56920 Cell Grid (Run 9)
Paticulate Organic Carbon
Model
Observed
mg/L
5
4
3
2
1
0
20
40
60
80
100
Percent Less than

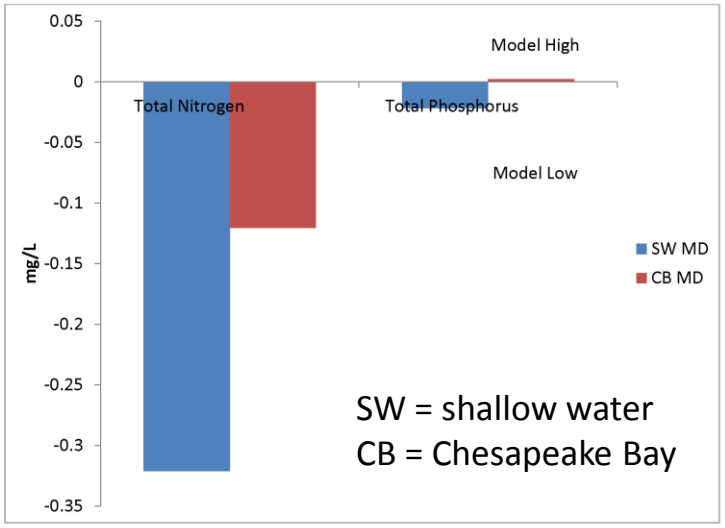

56920 Cell Grid (Run 9)
Particulate Phosphorus
Model
Observed
mg/L
0.1
0.08
0.06
0.04
0.02
0
20
40
60
80
100
Percent Less than

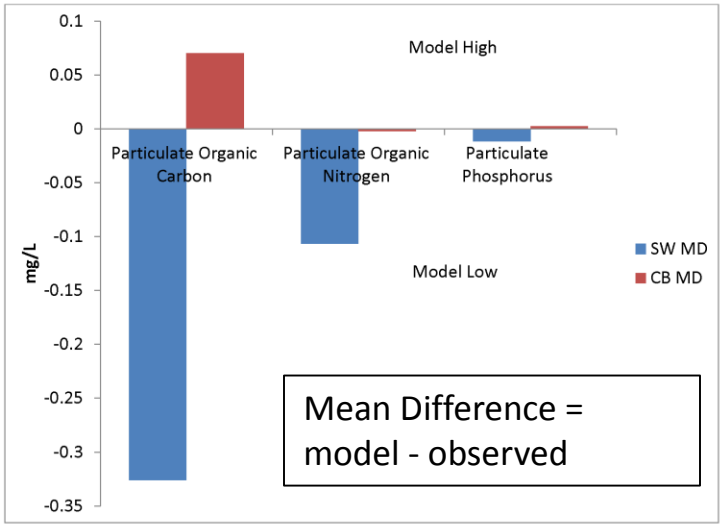

56920 Cell Grid (Run 9)
Total Phosphorus
Model
Observed
0.15
0.1
0.05
mg/L
0
20
40
60
80
100
Percent Less than

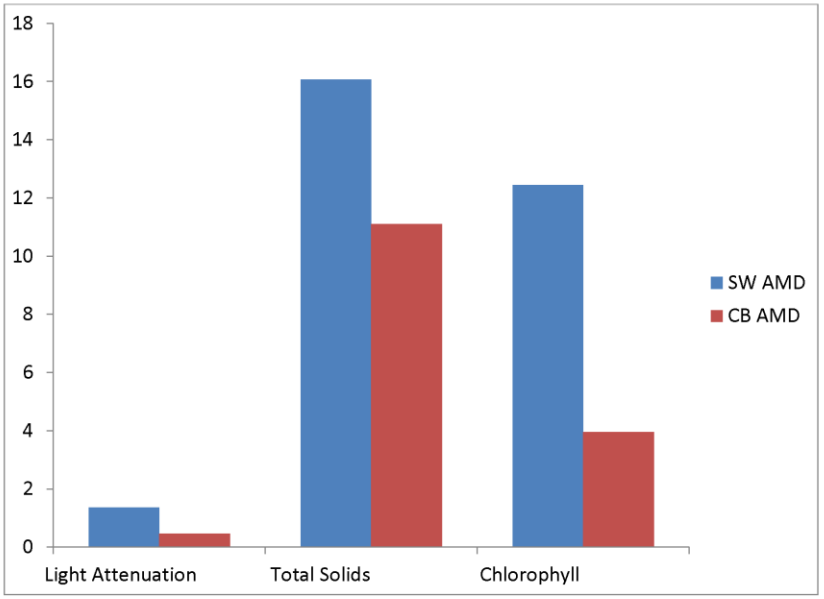

56920 Cell Grid (Run 9)
Total Nitrogen
Model
Observed
2
1.5
1
0.5
mg/L
0
20
40
60
80
100
Percent Less than

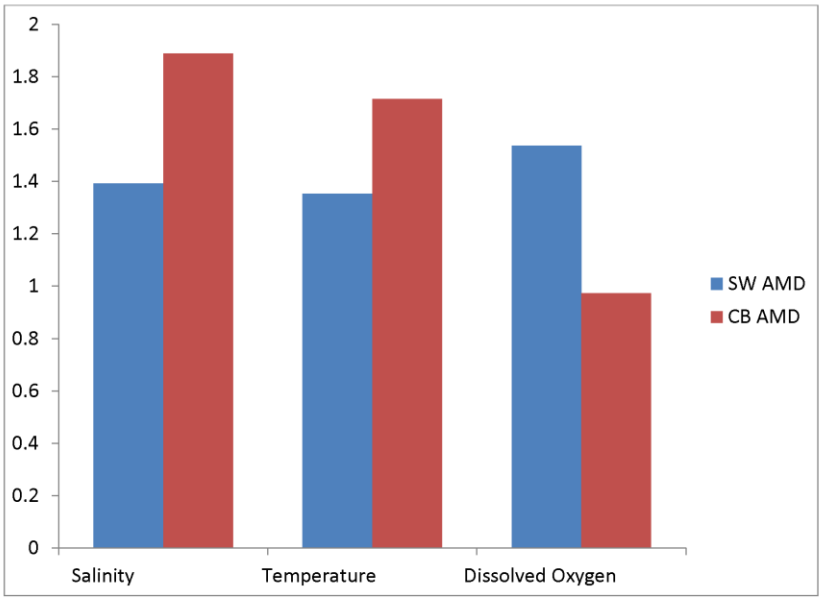

1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Model High
Model Low
SW MD
CB MD
Salinity
Temperature
Dissolved Oxygen

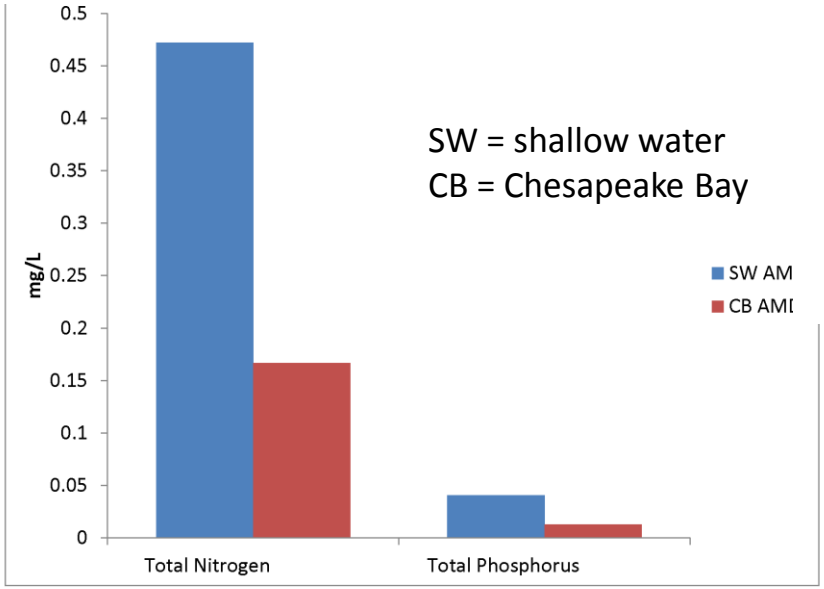

8
6
4
2
0
-2
-4
-6
-8
Model High
Model Low
SW MD
CB MD
Light Attenuation
Total Solids
Chlorophyll


0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
mg/L
Model High
Model Low
SW MD
CB MD
Total Nitrogen
Total Phosphorus
SW = shallow water
CB = Chesapeake Bay


0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
mg/L
Model High
Model Low
SW MD
CB MD
Particulate Organic Carbon
Particulate Organic Nitrogen
Particulate Phosphorus
Mean Difference = model - observed







SW = shallow water
CB = Chesapeake Bay

Absolute Mean Difference characterizes the distance between computations and observed.

Performance Summary

- In shallow water, the model provides representative computations of physical quantities: temperature, salinity, dissolved oxygen.
- Performance is comparable to model performance in the mainstem Bay.

Performance Summary

- In shallow water, there is little correspondence between individual observations and computations of “biogeochemical” substances.
- In shallow water, the model falls short in computation of all particulates, organic and inorganic.
- In this regard, model performance differs between shallow water and mainstem Bay.

What's Going On and What to Do?

- Our wind-wave model is "fetch limited." Where there's no fetch there are no waves, limited bottom shear stress.
- This affects areas in constrained tributaries but not open shorelines.
- This influences inorganic particles but not organic particles which are not incorporated in the sediment transport model.

What's Going On and What to Do?

- We don't have any data on the particle distribution of eroding shorelines and marshes. We might have a significant fraction of small particles ("wash load").
- Increasing the fraction of fines in our bank erosion load will likely increase TSS in nearshore areas. We don't know the impact on the mainstem Bay.

What's Going On and What to Do?

- Organic particles still use our old concept of net settling so resuspension is not an issue.
- In shallow water, the net settling out of the water column is 1% of settling rate through the water so we're not settling a lot of material in any event.
- It appears we need more primary production of organic particles in shallow water.

What's Going On and What to Do?

- How do we increase phytoplankton abundance and production in shallow water without adversely affecting the computations in open water?
- Resuspension of benthic algae?.