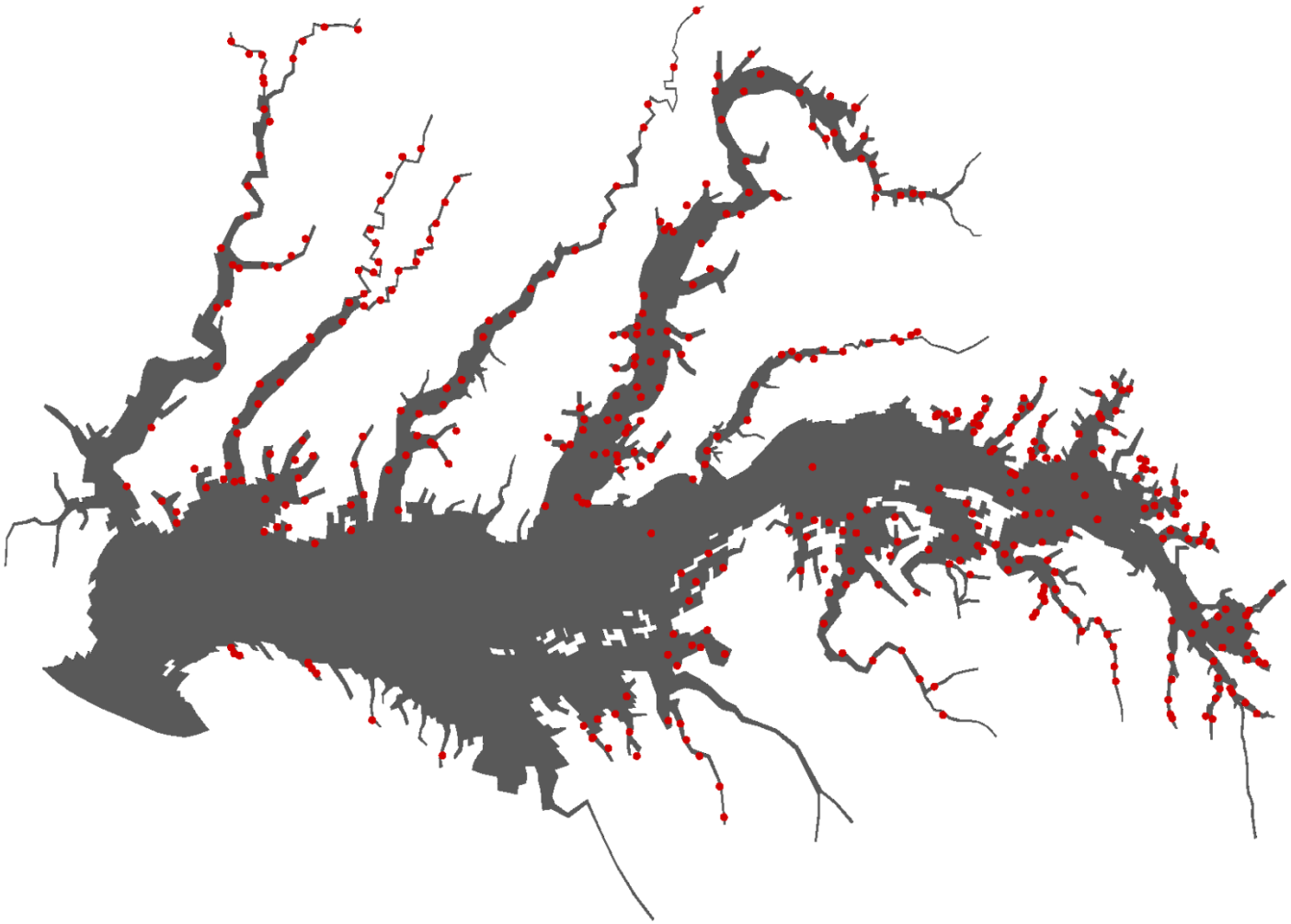
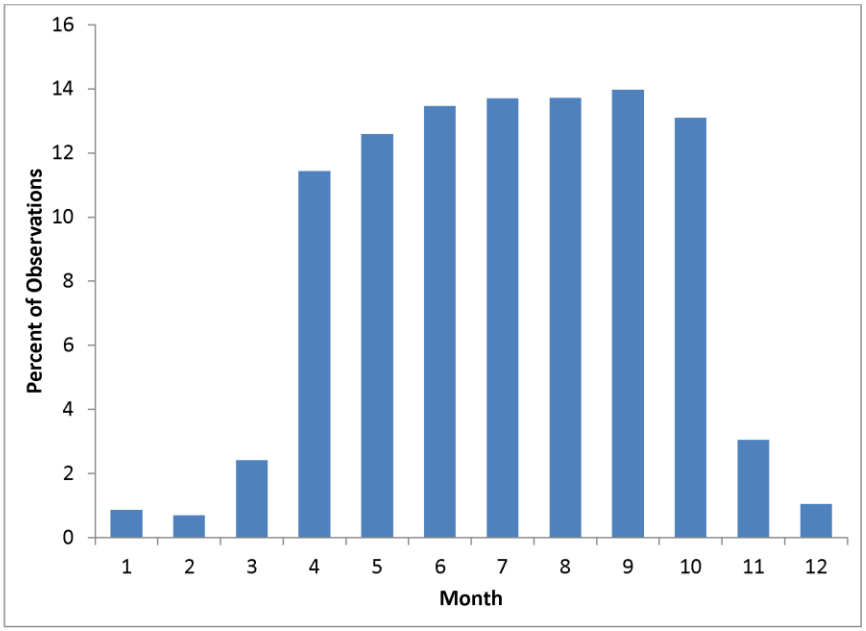
Three Topics

- Where are we?
- What are you getting?
- Where are we going?

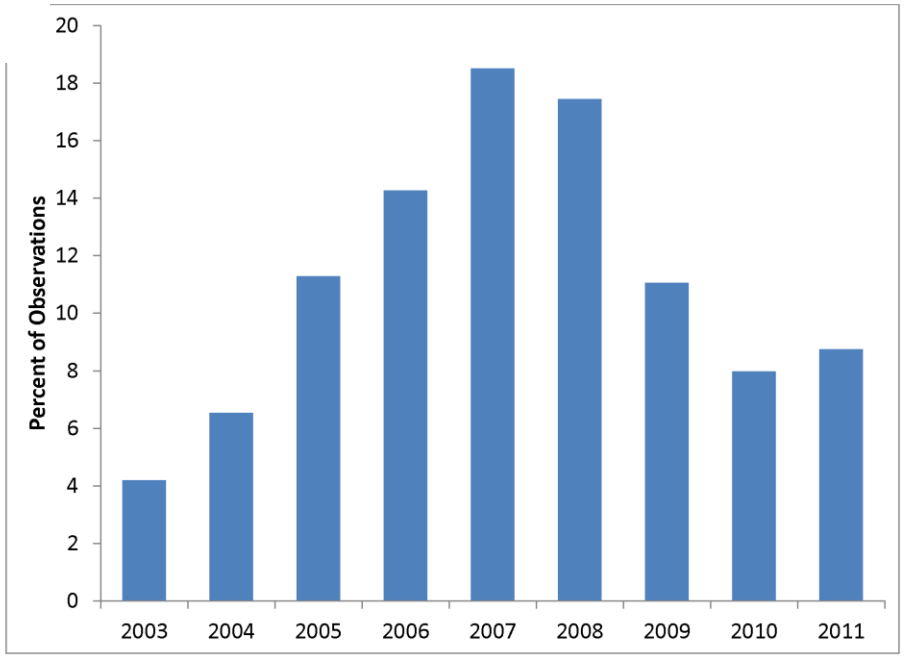
WQSTM Shallow-Water Simulation

- 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.



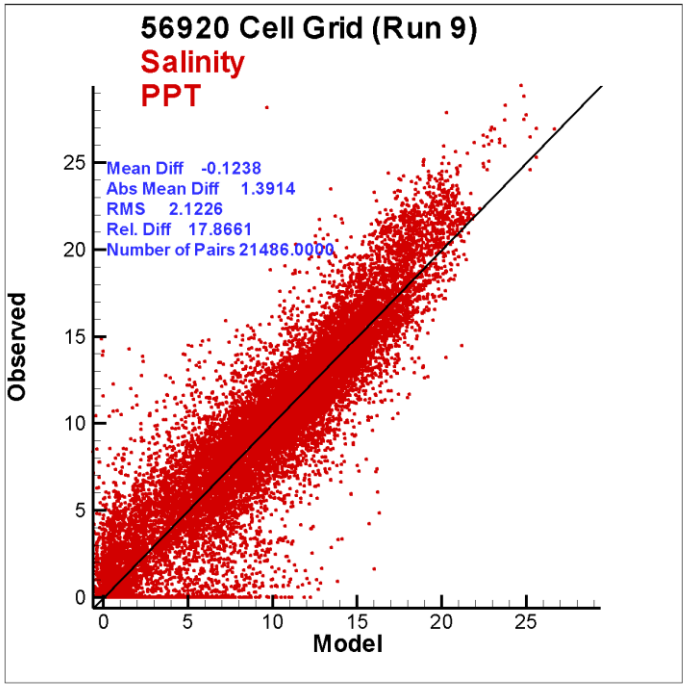


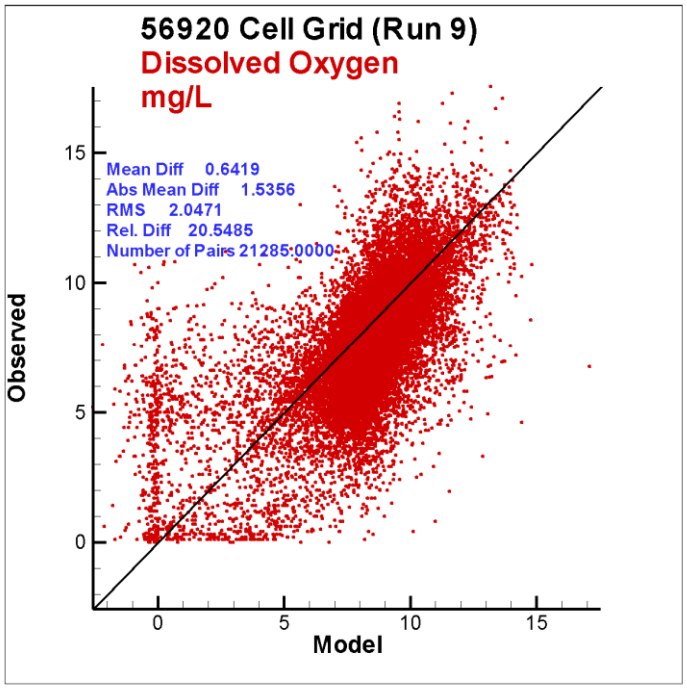
- Observations are evenly distributed from April to October.
- Peak sampling 2006 – 2008.
- We need a model from 2003 to 2011 to encompass these observations.

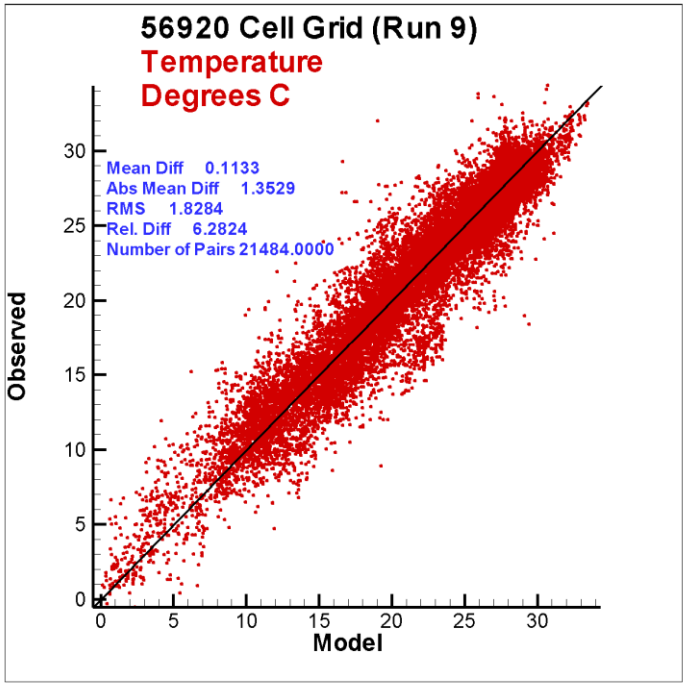


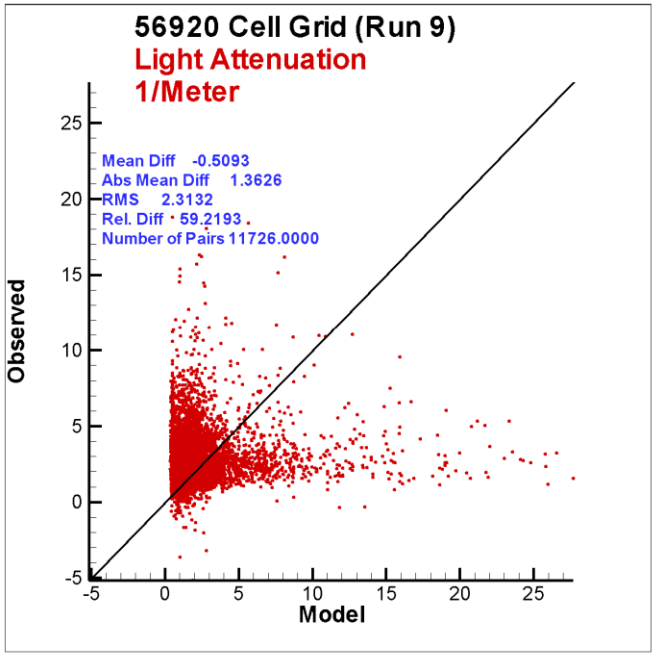
WQSTM Shallow-Water Simulation

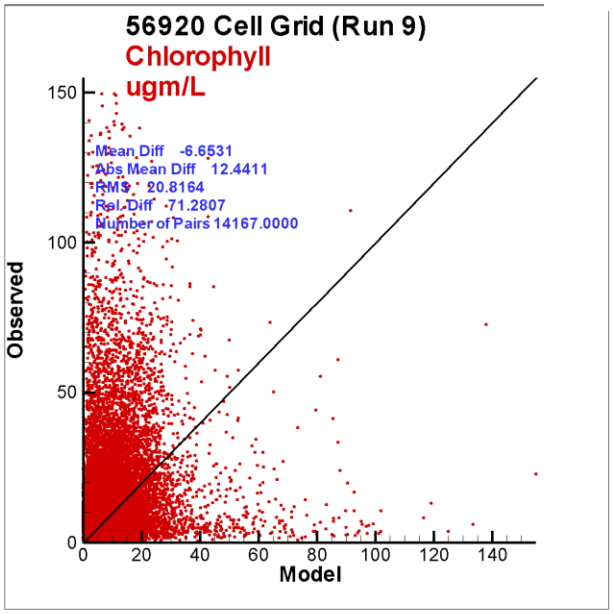
- We are now running 2002 – 2011 as our calibration and development focus.
- Three graphical examinations of performance in shallow water:
  - Scatter plots of computed vs observed.
  - Cumulative distribution plots of computed and observed.
  - Comparisons to performance in deep water.

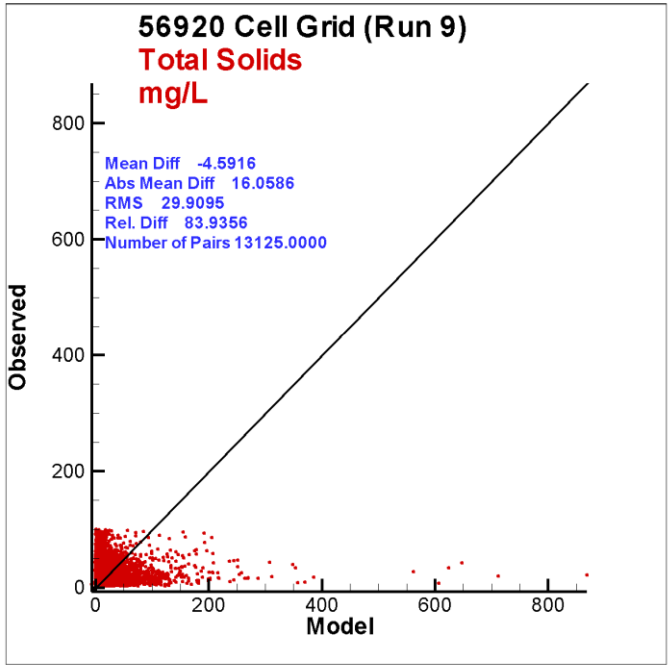

56920 Cell Grid (Run 9)
Salinity
PPT
Mean Diff -0.1238
Abs Mean Diff 1.3914
RMS 2.1226
Rel. Diff 17.8661
Number of Pairs 21486.0000
Observed
Model
0
5
10
15
20
25


56920 Cell Grid (Run 9)
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

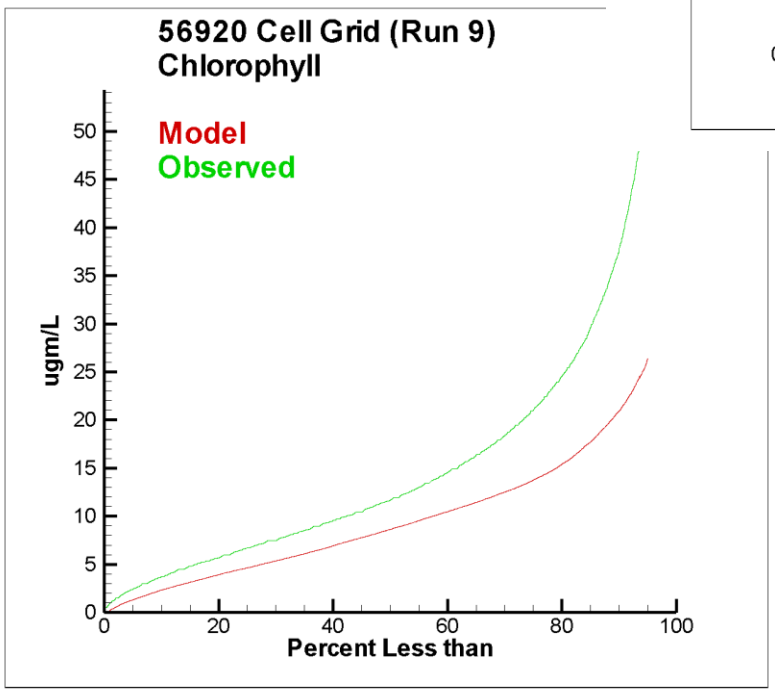

56920 Cell Grid (Run 9)
Temperature
Degrees C
Mean Diff 0.1133
Abs Mean Diff 1.3529
RMS 1.8284
Rel. Diff 6.2824
Number of Pairs 21484.0000
Observed
Model
0
5
10
15
20
25
30

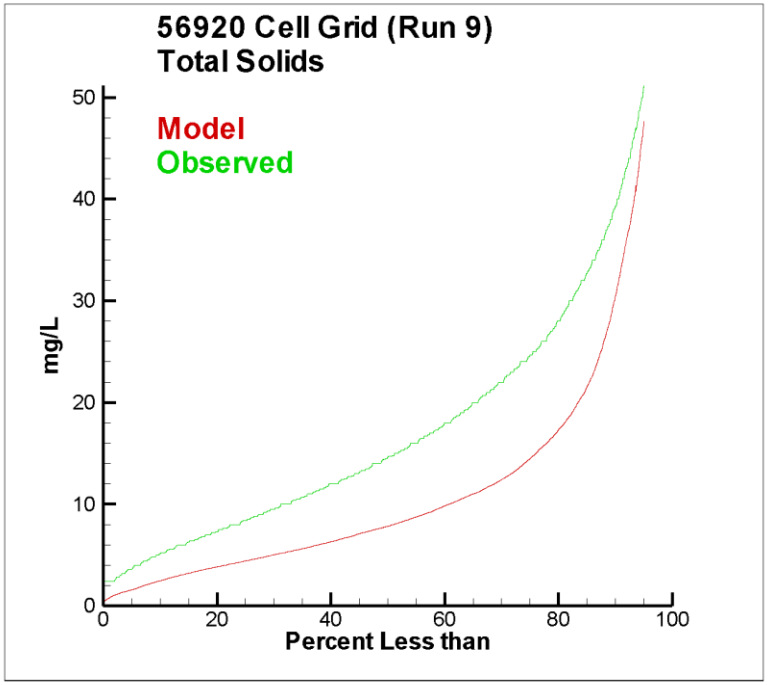

56920 Cell Grid (Run 9)
Light Attenuation
1/Meter
Mean Diff -0.5093
Abs Mean Diff 1.3626
RMS 2.3132
Rel. Diff 59.2193
Number of Pairs 11726.0000
Observed
Model
25
20
15
10
5
0
-5
-5
0
5
10
15
20
25


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)
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

Performance Summary

- In shallow water, the model provides representative computations of physical quantities: temperature, salinity, dissolved oxygen.
- In shallow water, the model falls short in computing suspended solids, light attenuation, chlorophyll.
- In shallow water, there is little correspondence between individual observations and computations of “biogeochemical” substances.

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.
- A model with more resolution and/or improved wave dynamics might provide a better representation of bottom shear stress.

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.
- The shallow-water teams might investigate effects of varying particle size in eroded material.

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?.
- A new shallow-water algal group?

A Few Other Ideas

- The common shortfall in TSS and KE suggests a cause and effect relationship. However… We are using C. Gallegos advanced optical model. The model parameterization might require revision is shallow water e.g. scattering or color.
- Is there a “fluff” layer of easily resuspended material in backwaters and embayments?

What Are You Getting?

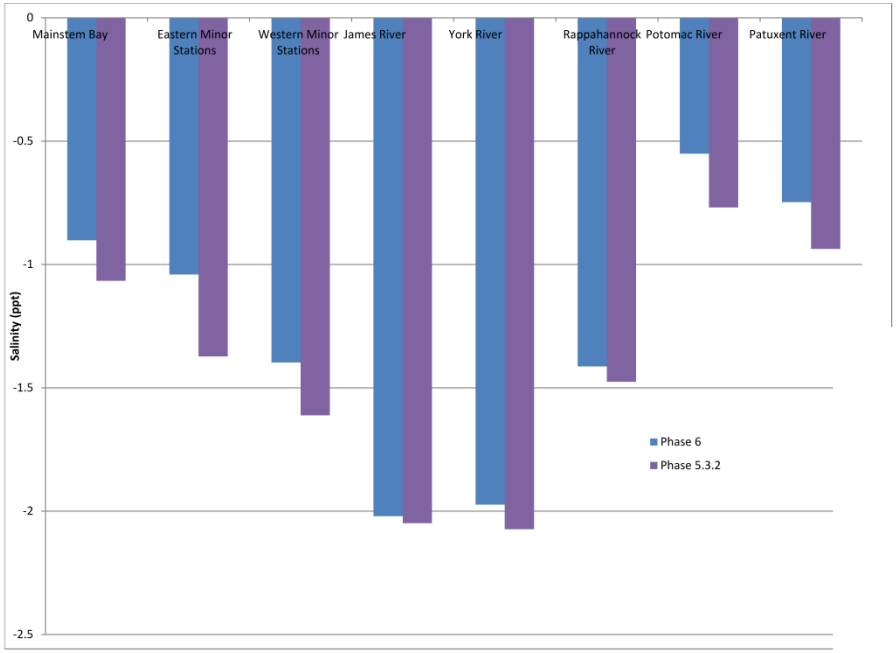
- We have passed to the CBP Ches_2015_Run30. The CBP has code, files, pre- and post-processors. The CBP has run the package and is extracting material for shallow-water teams.
- All model state variables and calibration parameters are exactly as for the 2010 model version used in the determination of TMDL's.

What Are You Getting?

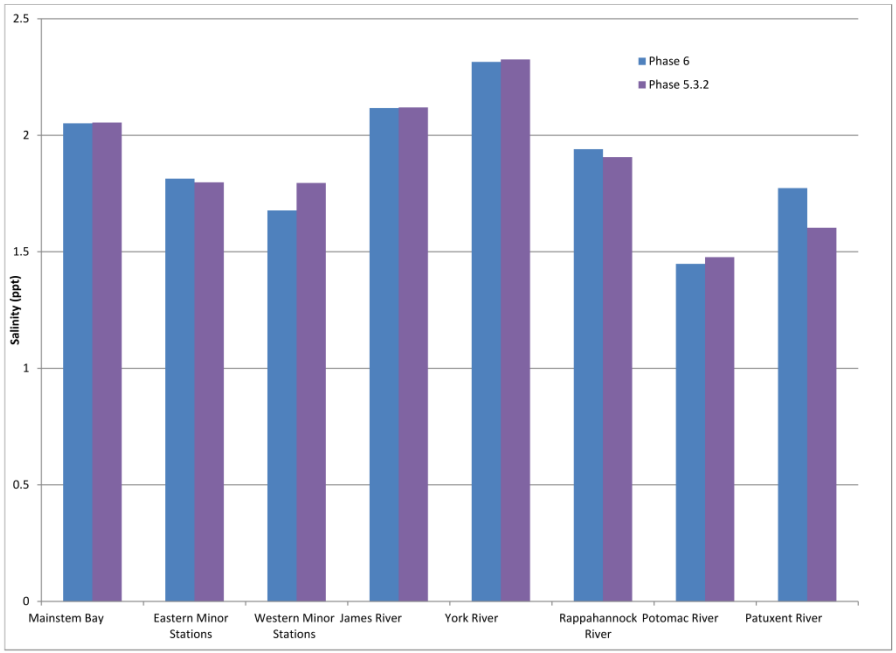
- Run30 simulates 2002 – 2011 using hydrodynamics as provided by the CBP.
- Watershed loads are from Phase 6 of the WSM as provided April 17, 2015.
- WQM results based on WSM Phase 6 loads are comparable to but not identical to results based on WSM Phase 5.3.2 (to which the WQM was calibrated).

Salinity

Mean Difference

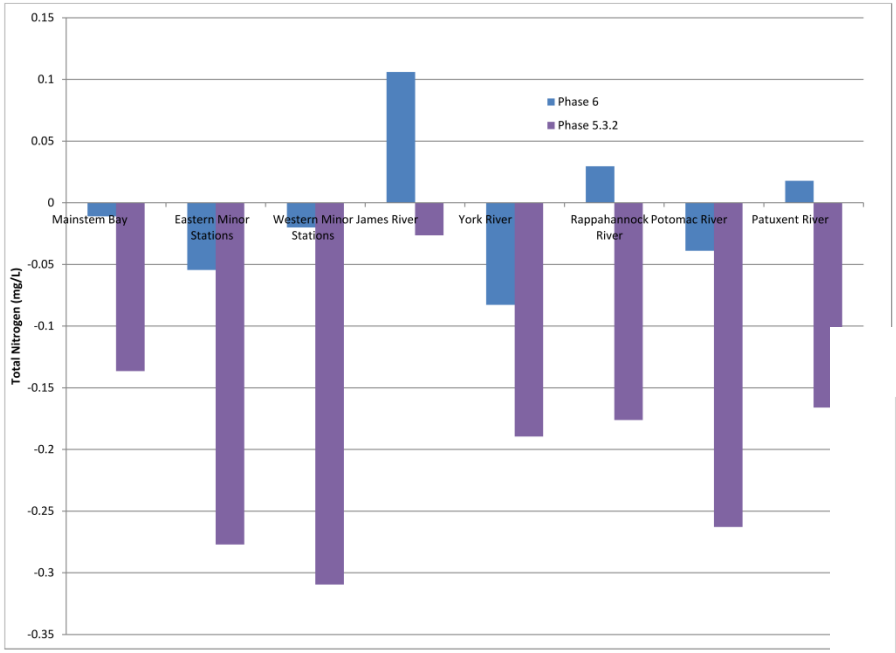


Absolute Mean Difference

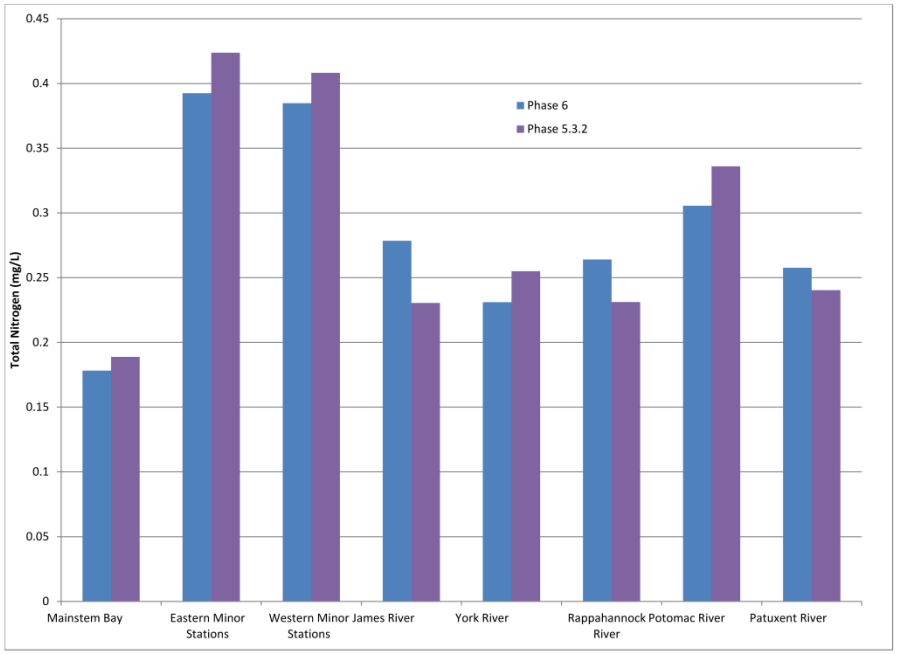


Total Nitrogen

Mean Difference

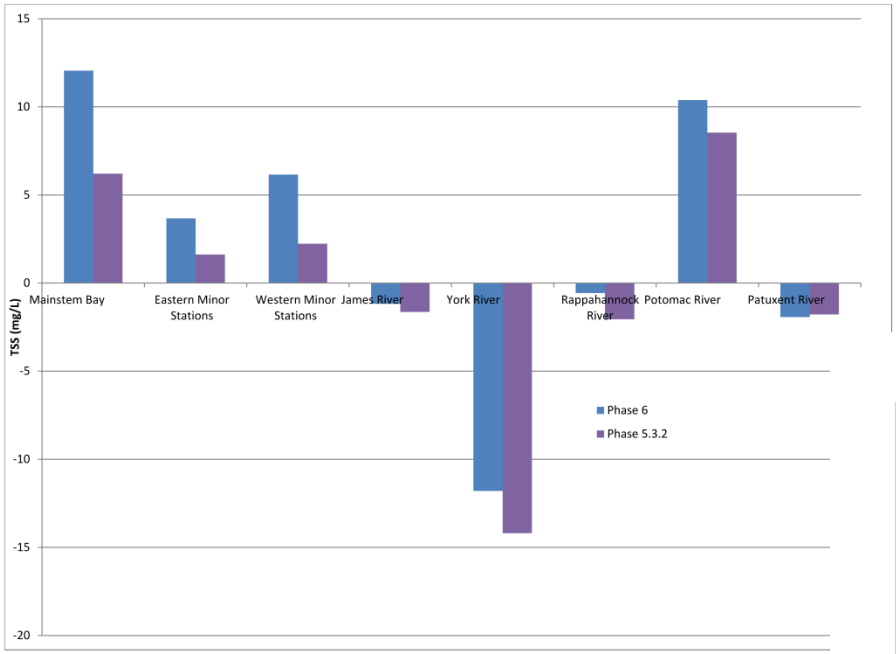


Absolute Mean Difference

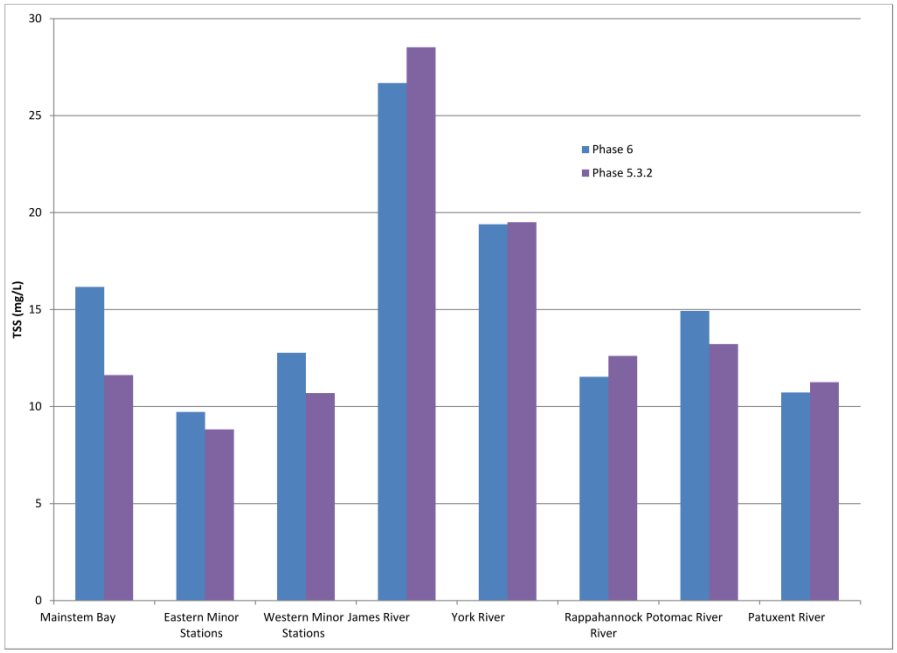


Total Suspended Solids

Mean Difference

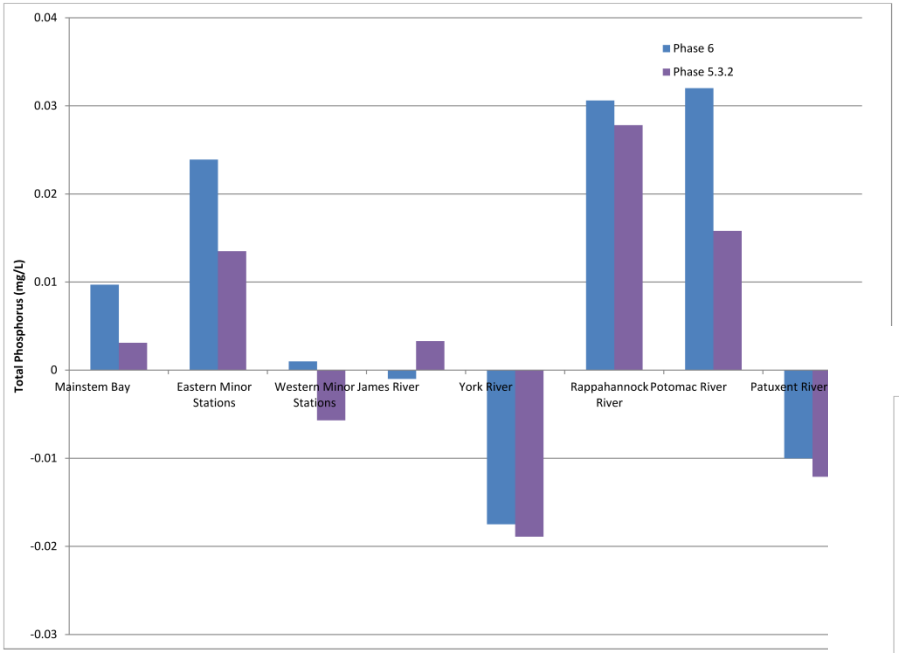


Absolute Mean Difference

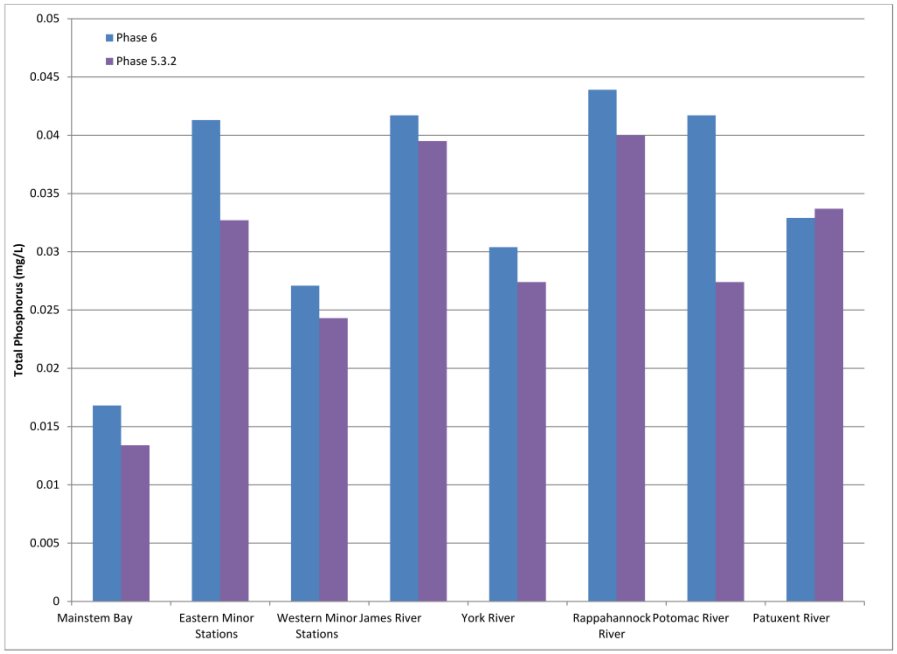


Total Phosphorus

Mean Difference



Absolute Mean Difference



What Are You Getting?

- Run30 incorporates shoreline erosion loads based on long-term recession rates. Solids only, no nutrients. Same rates as determined for 2010 version but no attempt to relate to daily waves or sea level.
- Run30 incorporates atmospheric loads of total nitrogen and total phosphorus to Chesapeake Bay provided by CBP July 2013. Allocated to fractions based on 2010 model. Allocated to surface cells based on area. Vary on annual basis.
- WQM and hydrodynamic model use independent boundary conditions for salinity and temperature. May vary slightly.

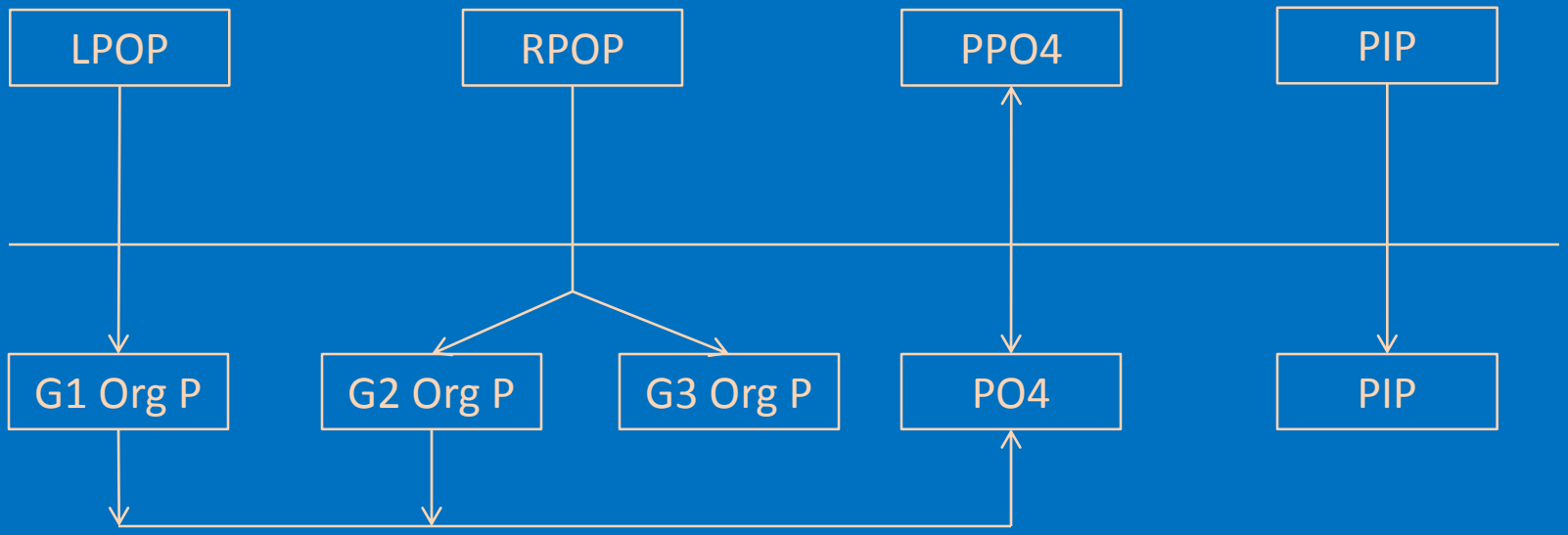
Where Are We Going?

- Phase 6 WSM loads are a work in progress. The present loads were approved by MARS as sufficient to move forward on 2002 – 2011 simulations. However, we know these are not the final set.
- Atmospheric loads will likely be revised to incorporate spatial and temporal variation. No time frame available.
- The CBP has the technology and ability to provide updated model results as new loads and other revisions become available.

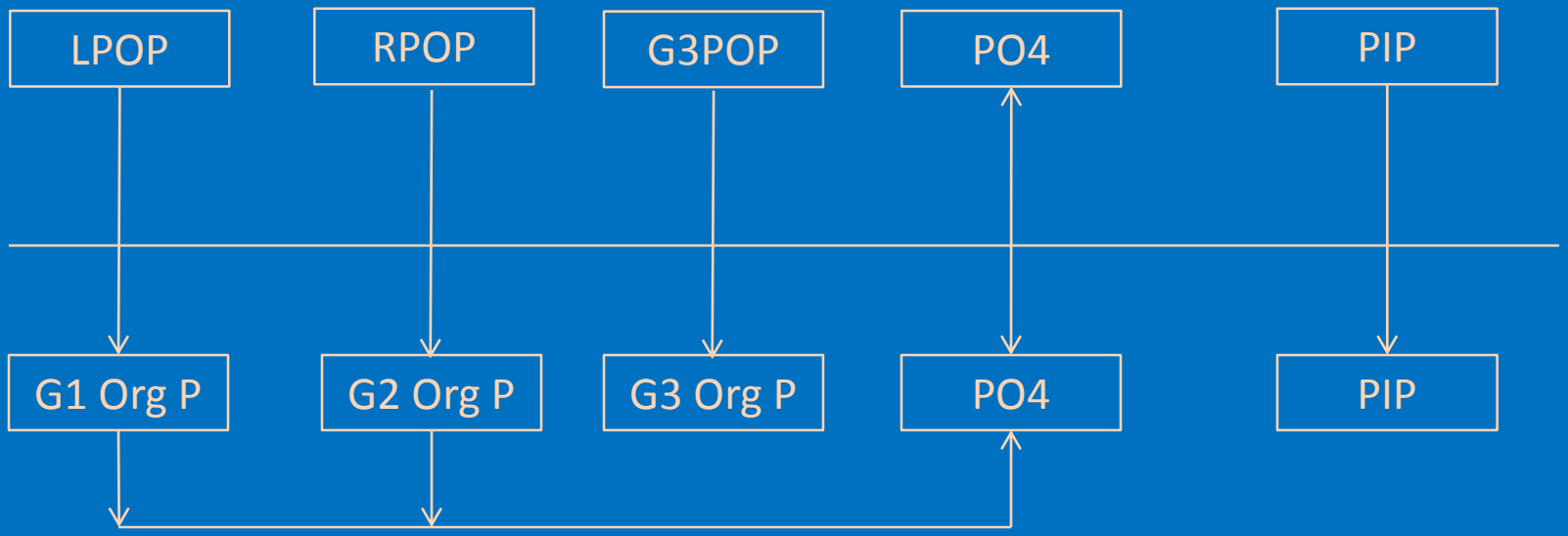
Where Are We Going?

- ERDC is moving forward on the issue of nutrient loads from shoreline erosion. These are not in the version provided to shallow-water teams.
- Next version WQM has labile, refractory, inert particulate matter in the water column corresponding to G1, G2, G3 in sediment diagenesis model.
- ERDC will be improving its own computations in shallow water based on system-wide data set.
- Climate change, sea-level rise and marsh erosion.

Former Routing of Water Column P to Sediments



Revised Routing of Water Column P to Sediments



Watershed vs Bank Nutrient Loads

- Watershed loads are 1991-2000 average from Phase 5.3.2 WSM.
- Bank loads are from WQGIT and 50,000 cell model solids loads.
- System-wide, bank nitrogen loads are 1.3% of watershed total nitrogen loads; bank phosphorus loads are 14.1% of watershed total phosphorus loads.