Shallow-Water Modeling in the CBEMP

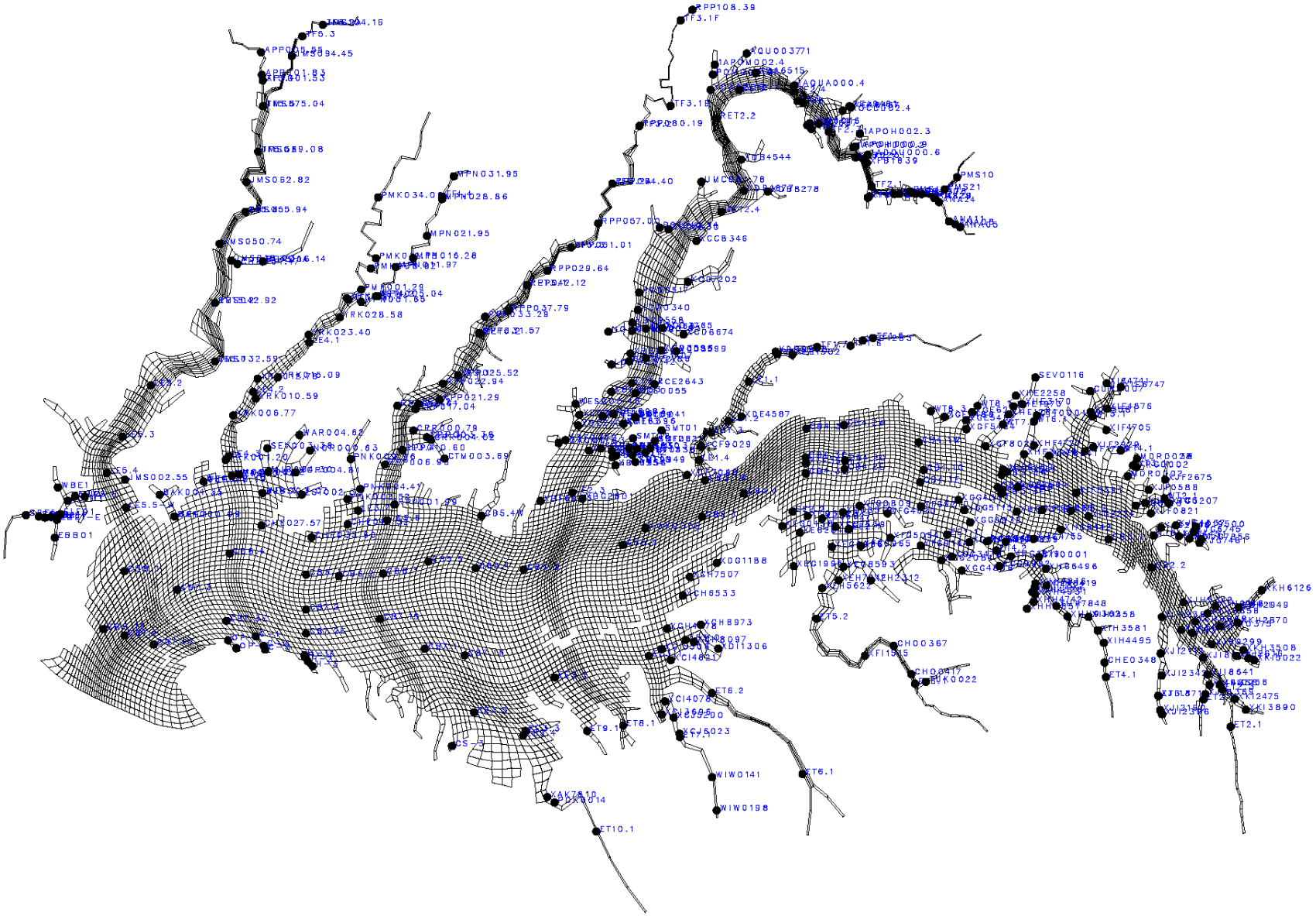
- Three issues:
  - Shallow-Water Monitoring Program.
  - Extension of the model to 2011.
  - How to model shallow water?

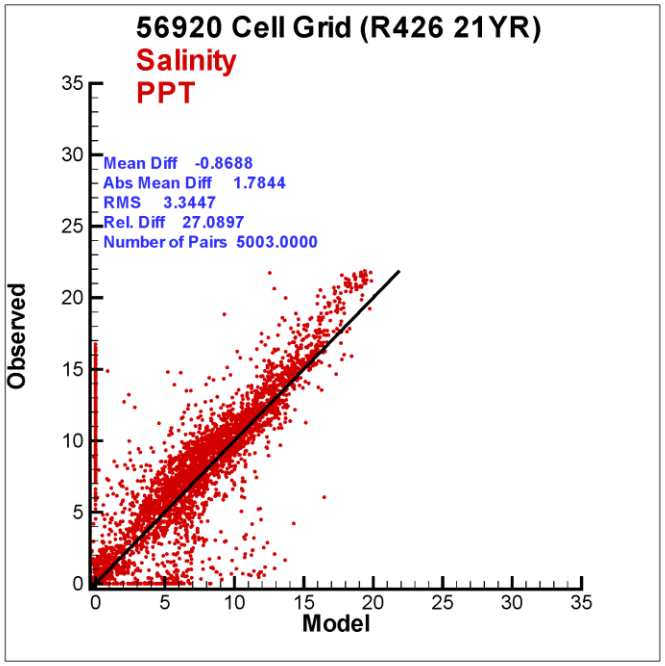
Shallow-Water Monitoring Program

- Program commenced circa 2001.
- Most observations post 2005.
- The shallow-water data found limited use in the previous phase of Chesapeake Bay modeling.
- This phase plans full examination of the data and employment to the greatest extent possible.

Shallow-Water Monitoring Program

- Three classes of observations
  - Grab samples.
  - Continuous monitoring at fixed station.
  - Continuous monitoring from moving vessel.
- The database of grab samples provided by CBP to ERDC
  - Cleaned up and mapped to model grid.
  - Observations extend from 2003 to 2011.
  - Initial comparison to our 1985 – 2005 simulation.




56920 Cell Grid (R426 21YR)
Salinity
PPT
Mean Diff -0.8688
Abs Mean Diff 1.7844
RMS 3.3447
Rel. Diff 27.0897
Number of Pairs 5003.0000
Observed
Model
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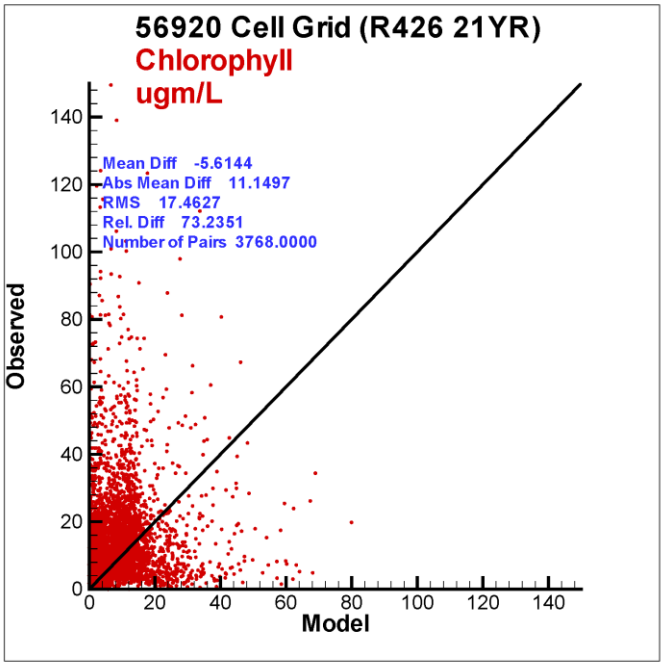
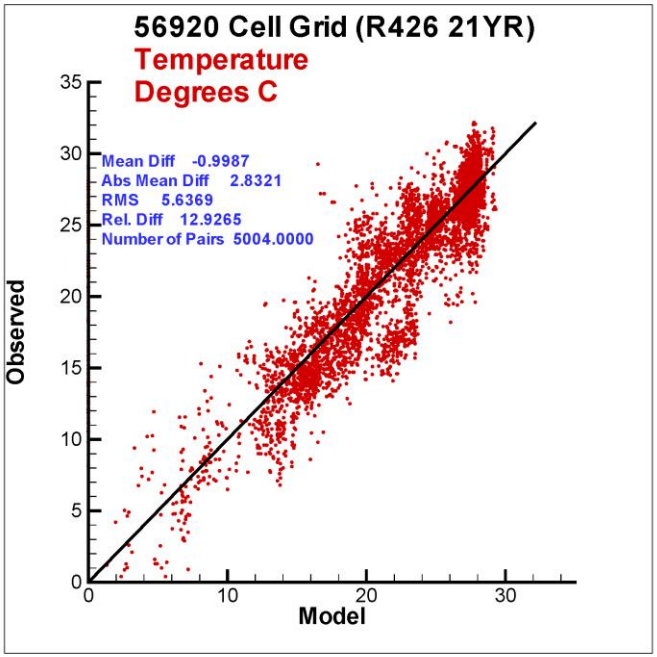
10
15
20
25
30
35


56920 Cell Grid (R426 21YR)
Chlorophyll
ugm/L
Mean Diff -5.6144
Abs Mean Diff 11.1497
RMS 17.4627
Rel. Diff 73.2351
Number of Pairs 3768.0000
Observed
Model
0
20
40
60
80
100
120
140


56920 Cell Grid (R426 21YR)
Temperature
Degrees C
Mean Diff -0.9987
Abs Mean Diff 2.8321
RMS 5.6369
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Number of Pairs 5004.0000
Observed
Model
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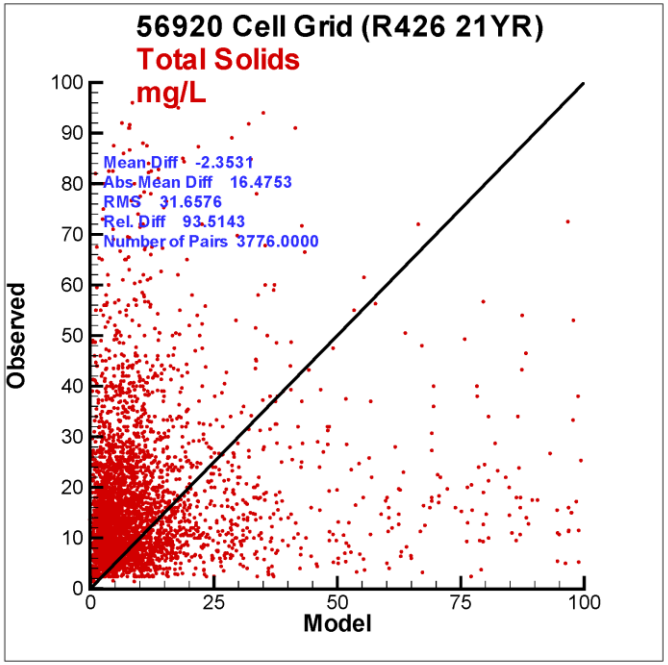
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Total Solids
mg/L
Mean Diff -2.3531
Abs Mean Diff 16.4753
RMS 31.6576
Rel. Diff 93.5143
Number of Pairs 3776.0000
Observed
Model
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75
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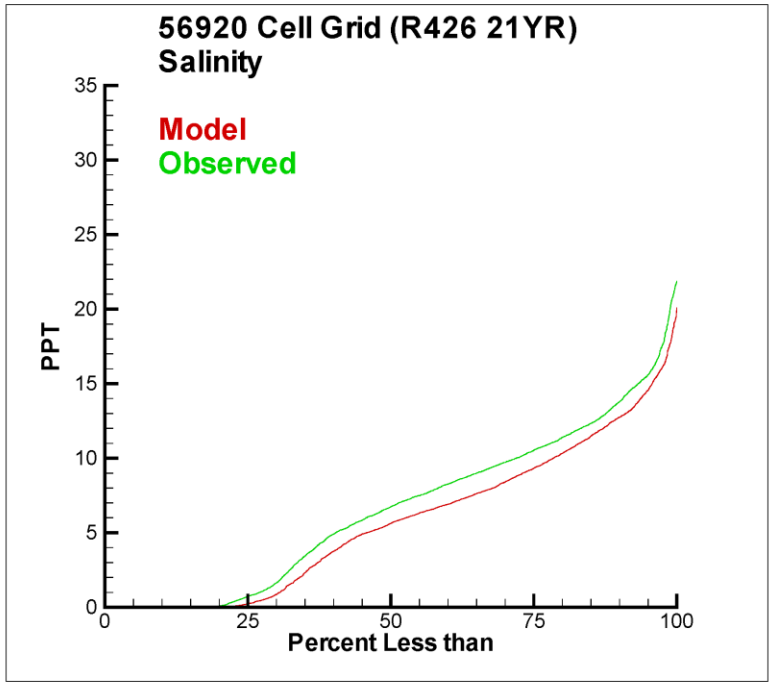
56920 Cell Grid (R426 21YR)
Salinity
Model
Observed
PPT
Percent Less than
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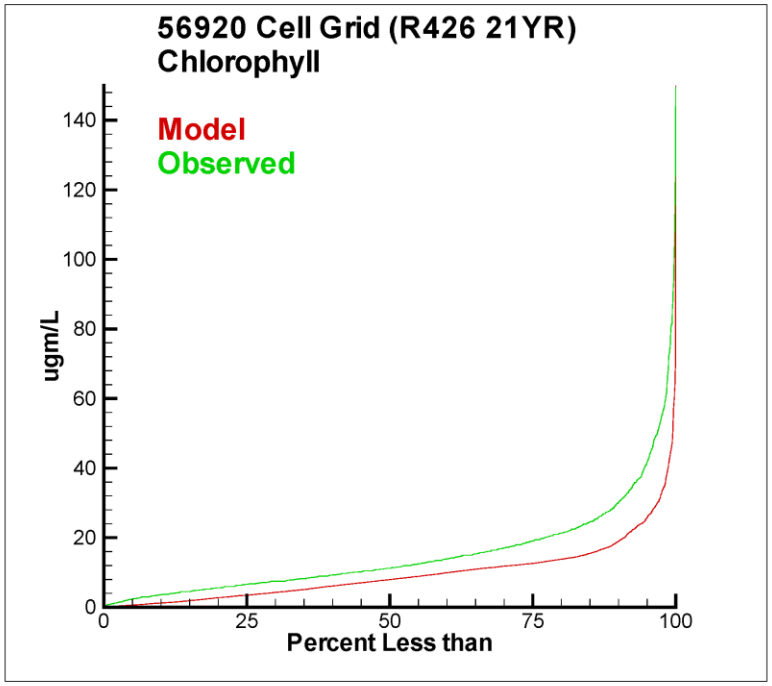
56920 Cell Grid (R426 21YR)
Chlorophyll
Model
Observed
ugm/L
Percent Less than
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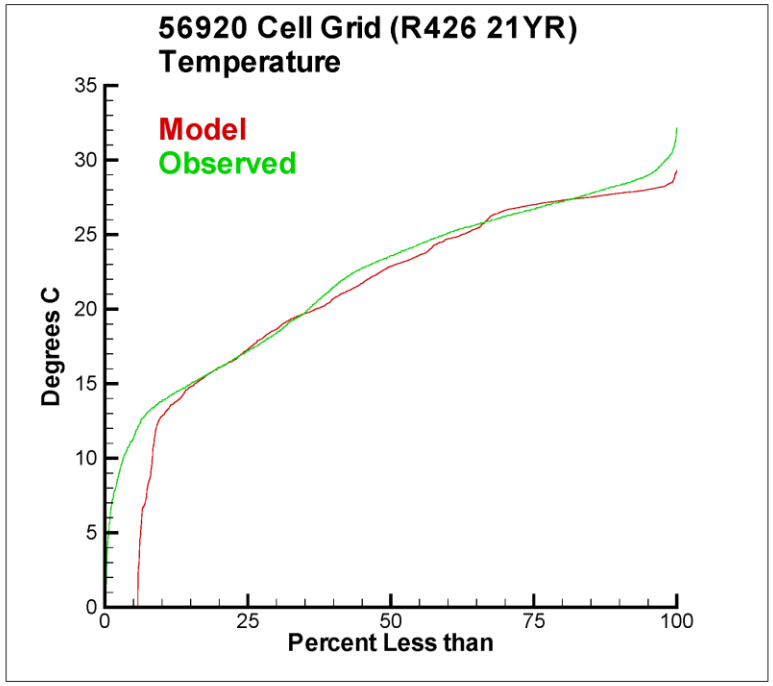
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Temperature
Model
Observed
Degrees C
Percent Less than
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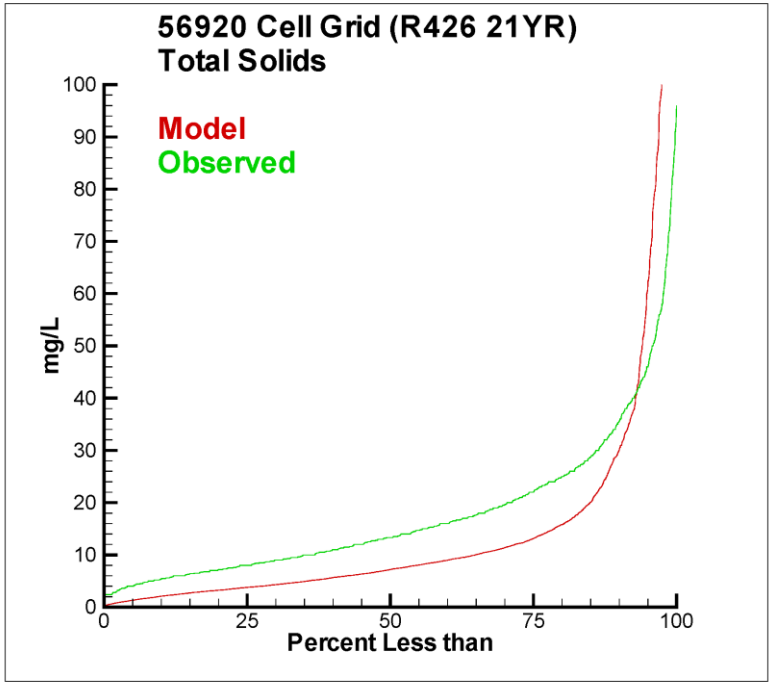
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Total Solids
Model
Observed
mg/L
Percent Less than
0
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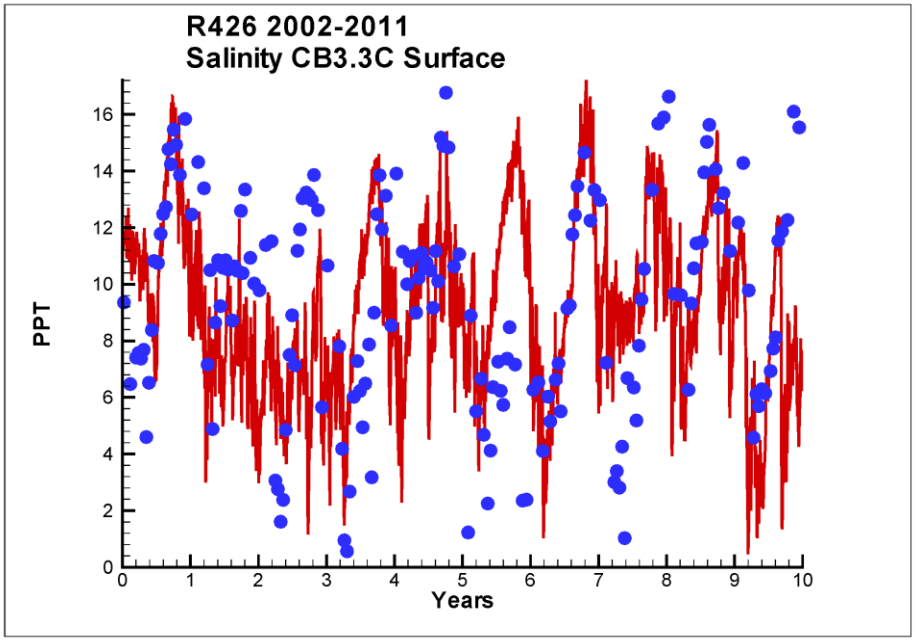
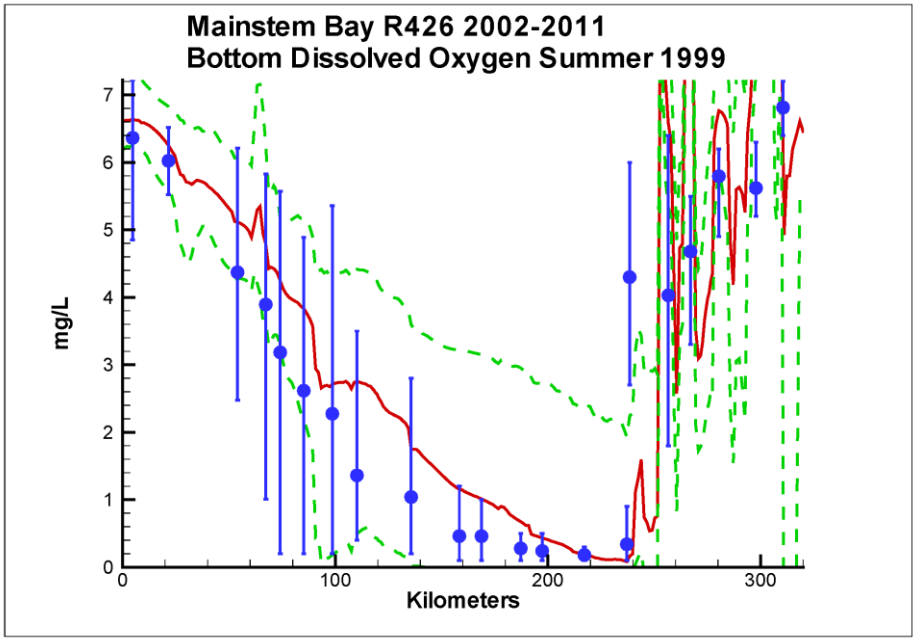
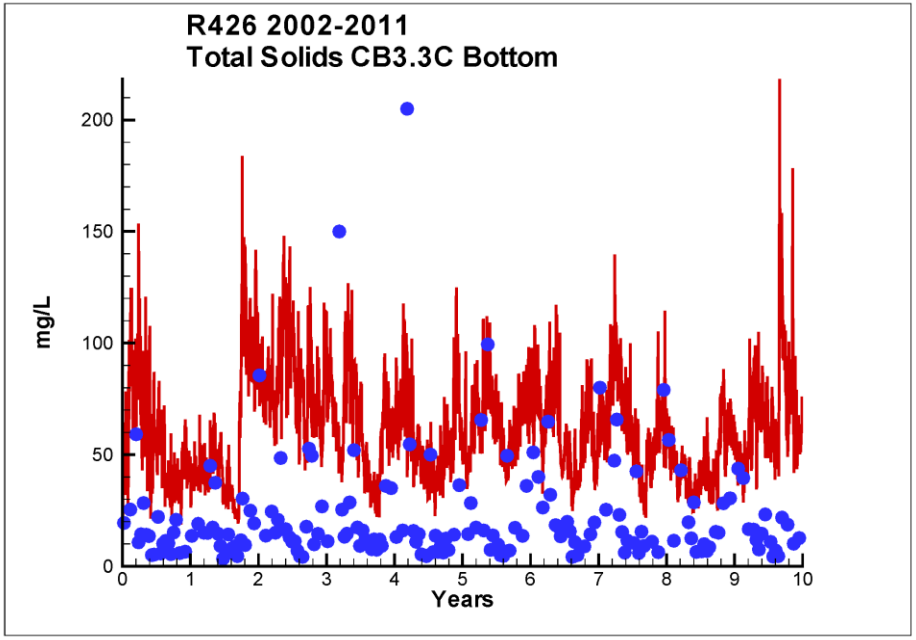
90
100
0
25
50
75
100

Extension to 2011

- Hydrodynamics
  - Hydrodynamics completed for 2002 – 2011 based on new Watershed Model application.
  - Accompanying bottom-shear stress file.
  - Received and tested by ERDC.







- Quick check on hydrodynamics
- Substitute new files into existing 1991 – 2000 simulation.
- They work, reproduce bottom-water hypoxia.
- Need to check shear-stress files.

Extension to 2011

- Watershed Model
  - 2002 – 2011 watershed loads provided to ERDC.
  - 2002 – 2011 point-source loads provided to ERDC.
- Atmospheric Deposition
  - Annual total nitrogen, total phosphorus loads to water surface provided to ERDC.
  - Need to be partitioned into fractions, time sequence.

Extension to 2011

- Meteorlogical Files
  - WQM met files for 2006 – 2012 provided to ERDC.
  - Based on same information as met files for hydrodynamic model.

Extension to 2011

- Shoreline Erosion
  - Need to compute daily bank erosion based on wave energy, water level.
  - We haven't done this in a long time.
  - Will require info on wind-waves created for bottom shear-stress computation.
- Process WSM outputs in WQM input files
  - Should be a routine process.

Extension to 2011

- Open-Mouth Boundary Conditions
  - Haven't done this in a while but should present no problems.
- Prepare Data for Calibration and Verification
  - We have downloaded data through 2011 from CBP.
  - Laborious process.
- Other Data e.g. SAV, SONE, PriPro
  - We have assembled the data but not processed for model employment.

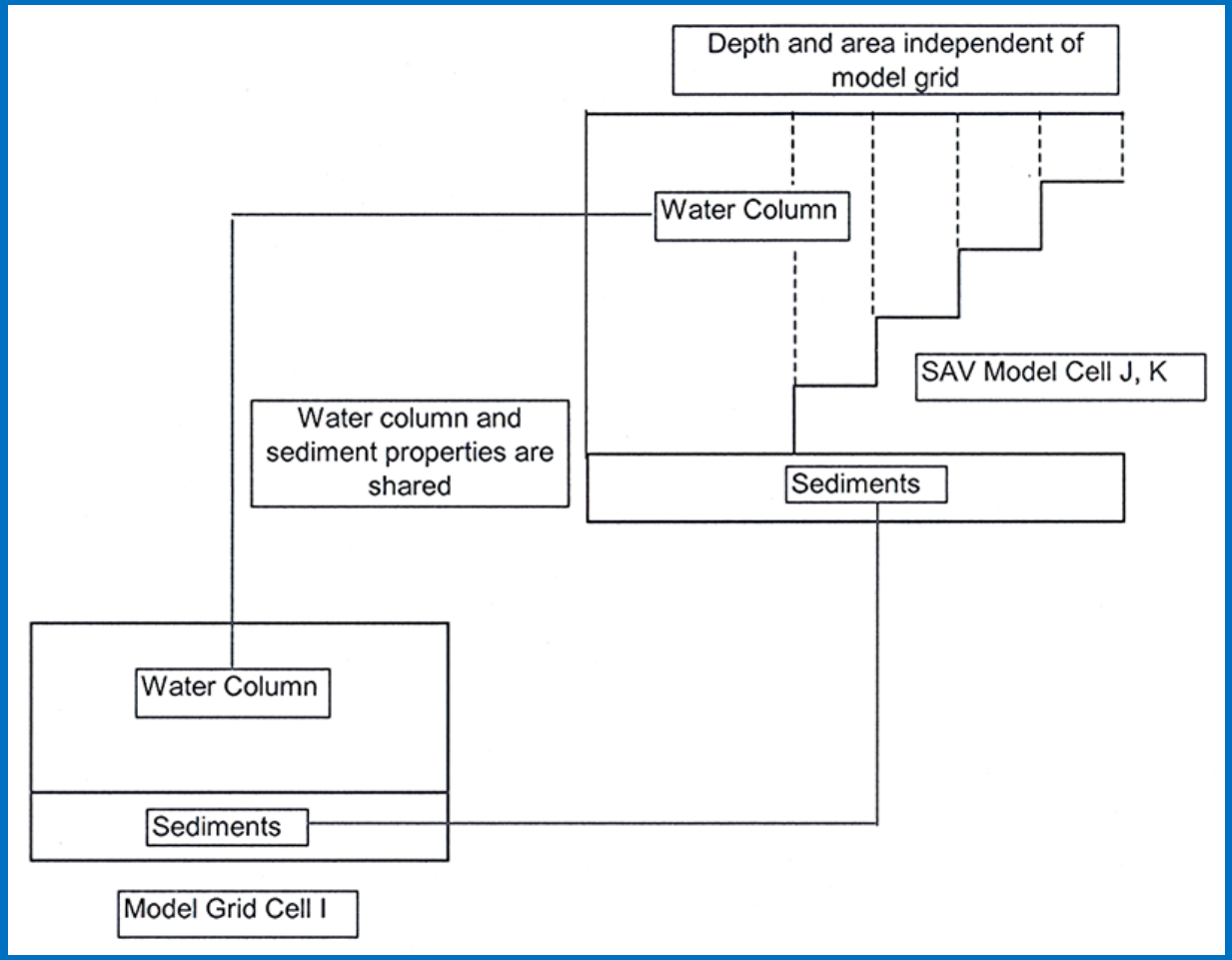
How to Model Shallow Water?

- Early discussions of an independent “Living Resource Ribbon” model.
- Use Adh or a similar unstructured-grid approach to provide a detailed representation of the shoreline.
- In view of time and resource constraints, this approach is infeasible by 2017.

How to Model Shallow Water?

- The geometry and depth of shoreline cells are restricted by CH3D grid structure.
- Within reasonable limits, we can adjust geometry within ICM. This approach is used in the present definition of SAV cells.
- We can use this approach in key areas or attempt widespread use.
- Will require a lot of GIS work to define cell geometry.

SAV Grid Cells



How to Model Shallow Water?

- Another option is do nothing regarding geometry and depth.
- Focus on calibrating existing shallow-water regions to the best extent possible.
- We have problems with resuspension. Probably due to absence of wave propagation into convoluted shallow regions. Adopt an empirical approach?
- Resuspend particulate organic matter?