James River CHLa Study

Model Calibration
Phase I: Hydrodynamic Model

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Model Development

• Watershed model
  – Flow (surface runoff, interflow, and groundwater)
  – Organic carbon, sediment
  – Nutrients (DON, NH$_4$, NO$_3$, OP, DOP, PO$_4$)
  – Point sources

• Hydrodynamic model
  – Surface elevation and current
  – Salinity
  – Temperature

• Eutrophication Model
  – Phytoplankton, nutrients and DO dynamics
Watershed Model

- Watershed model was developed by TetraTech, Inc. The Loading Simulation Program in C++ is being used for the simulation (http://www.epa.gov/athens/wwqtsc/html/lspc.html)
Watershed Segmentation and Total Organic Nitrogen Distribution
Observation Stations

Tide

Water Quality
Locations of NOAA Tidal Range Prediction

- Jordan Point
- Westover
- City Point (Hopewell)
- Sturgeon Point
- Claremont
- Jamestown Island
- Hog Point
- Mulberry Point
- Menchville
- Burwell Bay
- Huntington Park
- Hampton Roads (Sewells Point)
- Pig Point
Dynamics Model Setup

- Use Chesapeake Bay Model outputs (surface elevation, salinity, and temperature) as open boundary conditions.
- Use USGS freshwater discharge at Richmond, Appomattox River, and Chickahominy River.
- Use watershed model output for downstream discharge.
- Use observed wind and heat fluxes as surface forcings.
Model Skill Assessment

- Use visual comparison
- Compute statistics (root-mean-square error, mean error, relative error etc.)
- Use model skill
- Use scatter plot
- Use Tayler diagram

\[ SS = 1 - \frac{\sum (A_{\text{model}} - A_{\text{measured}})^2}{\sum (A_{\text{measured}} - \bar{A}_{\text{measured}})^2} \]
Surface Elevation

- Mean calibration of tidal range (compare model results against NOAA tidal table)

Model skill $SS = 0.8424$

$$SS = 1 - \frac{\sum \left( A_{model} - A_{measured} \right)^2}{\sum \left( A_{measured} - \bar{A}_{measured} \right)^2}$$
Sewells Point

Elevation (m)

Time (Day)

Pred
Obs
Salinity
Temperature
Model Skill

James Temperature

Temperature (C°)

Temperature (C°)

CC=0.99
SS=0.99

James River Temperature

Reference
Conclusion

• Preliminary dynamic model calibration yields good model prediction skill
• Refinement of model calibration will be conducted to further improve model results
  – Using data assimilation method to incorporate observations to model simulations
  – Assess the change of dynamic fields (horizontal and vertical transport timescales)