

Savannah Harbor Data Analysis and Modeling Federal Agencies Expectations

Background:

The purpose of the 1997 Savannah Harbor data collection and subsequent modeling activities was to provide a hydrodynamic and water-quality model to analyze impacts of deepening on circulation, salinity, and dissolved oxygen. Due to the sensitivity of the aquatic resources to small changes in water level, salinity, and dissolved-oxygen concentration, the 1997 model was not adequate for making the necessary absolute predictions of water-level, salinity, and dissolved oxygen necessary to evaluate the mitigation issues associated with the potential deepening of the harbor.

The purpose of the 1999 Savannah Harbor data collection and modeling effort was to develop a defensible hydrodynamic and water quality model that can make the necessary absolute prediction to evaluate impact and mitigation issues. The 1999 data set provides the detailed data to develop this defensible hydrodynamic and water quality model.

Areas of Concern:

There are four resources of concern for Federal agencies. These are:

1. Shortnose sturgeon
2. Striped bass
3. Tidal Wetlands
4. Dissolved oxygen

Federal Agencies' Concerns:

The general concerns of the Federal Agencies are the accuracy of the model simulations, the model defensibility, and the availability of the 1999 data set. Concerning the adequacy of the model, the 1999 model hydrodynamic calibration, as currently presented in the Draft Calibration Report, does not show sufficient improvement over the 1997 hydrodynamic calibration. The model simulations are not adequate to provide the level of accuracy necessary to make sound ecological decisions for the identified four main areas of concern.

Certain standard modeling practices must be done to support the defensibility of the model. These include convergence testing of the model on the Savannah Harbor application, sensitivity analysis of all the significant model parameters, data analysis and description of boundary stations and critical stations within the model domain.

Some agencies have requested, over the last year, that the 1999 data be made available electronically to the Federal and State Agencies. This action has not occurred to date. Until

these data are available, it is impossible for the Federal Agencies to make a complete technical evaluation of how the model compares to actual data.

Modeling Expectations for the Hydrodynamic, Transport, and Temperature Model:

By Selective Parameters:

The following provides the Federal Agencies' viewpoint on the expected accuracy of the modeling results for selective parameters. The statistical analysis should be performed on the 1997 and 1999 data sets. For the 1999 calibration data set, analysis should be performed on each of the five spring/neap tidal cycles between July 31 and October 13, 1999. The Julian dates for the five periods are: 213-226, 227-241, 242-255, 256-270, and 271-285. (Need to identify spring/neap cycles for the validation data set. For the 1997 validation data set, analysis should be performed on each of the spring/neap tidal cycles between _____ and _____ 1997. The Julian dates for the ____ periods are: ____)

Water level:

- Water levels need to within 2 cm of the 5th, 50th and 95th percentile values.
- The timing of the maximum and minimum water levels and salinities need to be within 30 minutes of the measured timing.
- Important stations: Stations GPA 5, 6, 7, 8, 9, 10, IIR, 12R, 15, and USGS Stations 02198840 (1-95), 02198920 (Houlihan Bridge), 02198979 (Little Back River nr Limehouse), and 02198977 (Broad Street)

Salinity:

- For locations where the 50th percentile of the surface salinity values are greater than 5 ppt, surface salinities must be within 10% of the 50th and 90th percentile. For locations with 50th percentile values less than 5 ppt, surface salinities need to be within 0.5 ppt of the 50th and 90th percentile.
- The timing of the maximum and minimum water levels and surface salinities need to be within 30 minutes of the measured timing.
- Important stations - GPA 5, 6, 7, 8, 9, 10, IIR, 12R, 15, 22 and USGS Stations 02198840 (1-95), 02198920 (Houlihan Bridge), 02198979 (Limehouse), and 021989791 (USFW Dock).

Currents and flows:

- The simulated volume fluxes (need to be within 25 percent of the measured flux.
 - Important stations: 195, FRI, MRI, LBRI, FWI, FW2, FW2U, FW3, FR2, MR2, LBR2
- The simulated surface currents (top 2 meters) need to be within 25 percent of the measured currents.
 - Important stations: GPA6 and GPA14

- The timing of the maximum and minimum currents must be within 30 minutes of the measured timing.

Temperature:

- Due to their significant effects of temperature on the water-quality rate kinetics, the absolute mean error of the simulated values need to be within 1 degree Celsius of the measured temperature.
- Important stations-GPA 2,4,6,8,9,10,11R, 14, 21,and 22.

By Resources:

Sturgeon:

- Critical parameters and statistic
 - Bottom DO – 10th and 50th percentile
 - Bottom salinity – 50th and 90th percentile
- Critical time scale - hours for durations of DO concentrations below 3 mg/L
- Important stations- GPA8 and GPA22

Striped Bass:

- Critical parameter and statistics
 - High-tide surface salinities – 90th percentile
 - Ebb and Flood velocity of top 2 meters
- Critical time scale - hours (maximum duration of salinity excursion)
- Important stations - GPA 5, 6, 7, 8, 9, 10, 11R, 12R, 15, 22 and USGS Stations 02198840 (1-95), 02198920 (Houlihan Bridge), 02198979 (Limehouse), and 021989791 (USFW Dock).

Tidal Wetlands:

- Critical parameter-high tide water levels over 60 days (September and October)
- Critical time scale –daily, weekly to monthly
- Important stations -- GPA 5, 6, 7, 8, 9, 10, 11R, 12R, 15, and USGS Stations 02198840 (1-95), 02198920 (Houlihan Bridge), 02198979 (Little Back River near Limehouse), and 02198977 (Broad Street). 021989791 – USGS Stations USFWS Dock.

Model Defensibility:

Convergence testing:

- Convergence testing of the model must be performed on the application to the Savannah Harbor.

Sensitivity Analysis:

- Sensitivity analysis needs to be performed on selected model parameters and boundary inputs. (*Need to develop list.*)

Data Description and Analysis:

- For the 1999 data set, some time periods are missing due to equipment failure and an approaching hurricane. Data analysis and descriptions are needed that describe boundary stations and critical internal stations. Descriptions should include a general statistical summary and a narrative outlining over data quality and, for boundary stations, techniques used to fill period of missing record.

Modeling Expectations for the Water Quality (Dissolved Oxygen) Model:

The following provides the Federal Agencies' viewpoint on the expected accuracy of the modeling results for selective parameters. The statistical analysis should be performed on the 1997 and 1999 data sets. For the 1999 calibration data set, analysis should be performed on each of the five spring/neap tidal cycles between July 31 and October 13, 1999. The Julian dates for the five periods are: 213-226, 227-241, 242-255, 256-270, and 271-285. *(Need to identify spring/neap cycles for the validation data set. For the 1997 validation data set, analysis should be performed on each of the ___ spring/neap tidal cycles between ___ and ___ 1997. The Julian dates for the ___ periods are: ____.)*

The water-quality model must demonstrate that the simulated transport and temperature of the hydrodynamic model is accurately conveyed to the water-quality model. The same criteria used for the salinity and temperature evaluation of the hydrodynamic model will apply to the water-quality model.

By Selective Parameters- Salinity:

- For locations with 50th percentile of the surface salinity values are greater than 5 ppt, surface salinities must be within 10% of the 50th and 90th percentile. For locations with 50th percentile values less than 5 ppt, surface salinities need to be within 0.5 ppt of the 50th and 90th percentile.
- The timing of the maximum and minimum water levels and surface salinities need to be within 30 minutes of the measured timing.
- Important stations - GPA 5, 6, 7, 8, 9, 10, 11R, 12R, 15 and USGS Stations 02198840 (1-95), 02198920 (Houlihan Bridge), 02198979 (Limehouse), and 021989791 (USFW Dock).

Temperature:

- Due to their significant effects of temperature on the water-quality rate kinetics, the absolute mean error of the simulated values need to be within 1 degree Celsius of the measured temperature.
- Important stations-GPA 2, 4, 6, 8, 9, 10, 11R, 14, 21, and 22.

Dissolved Oxygen:

- Due to the naturally low dissolved-oxygen concentrations and the endangered species in the system, simulated bottom dissolved-oxygen concentrations need to be with 0.2 mg/L of the 10th and 50th percentile measured concentrations.
- The timing of the maximum and minimum dissolved oxygen must be within 30 minutes of the measured timing of the maximum and minimum concentration.
- Important stations-GPA2, 4,6,8,9,10,11R, 14,21, and 22.

By Resources:

Sturgeon:

- Critical parameters and statistic
 - Bottom DO -10th and 50th percentile
 - Surface salinity- 50th and 90th percentile
- Critical time scale - hours for durations of DO concentrations below 3 mg/L
- Important stations- GPA8 and GPA22

Dissolved-Oxygen:

- Critical parameter – 10th and 50th percentiles
- Critical time scale - hourly to daily
- Important stations --GPA2, 4,6,8,9,10,11R, 14,21,and 22.