APPLIED TECHNOLOGY AND MANAGEMENT

FINAL REPORT

REVIEW OF THE UNIVERSITY OF RHODE ISLAND, ROMS HYDRODYNAMIC MODEL APPLICATION TO NARRAGANSETT BAY

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1. Introduction

1.1. At the request of the Narragansett Bay Commission ATM has reviewed the University of Rhode Island report titled "Development and Calibration of a Model for Tracking Dispersion of Waters from Narragansett Bay Commission Facilities within the Providence River & Narragansett Bay", Final Report to the Narragansett Bay Commission, June 2007, prepared by Deanna Bergando and Chris Kincaid.

1.2. This review focuses on several key aspects of the report and the presented data and the model application. It is presented in three sections discussing: 1) the data, 2) the model application and grid and 3) the model calibration.

2. Data questions and comments

2.1. There are at least two data sets that appear in the report. One data set is discussed at some length in the early part of the report and yet when model to data comparisons are made it is for a different time period. It was not clear how many data sets were used or why the first one discussed was not used. It was also not clear whether all of the model-data comparisons were done for the same data set or time period.

2.2. Very little mention of tidal data was made in the report. Was any tidal data collected during either of the field programs?

2.3. It is also not clear whether a synoptic data set of all of the necessary hydrographic data was taken or whether the individual data sets were taken during separate time periods.

2.4. In order to perform a rigorous calibration, a synoptic data set should be used, including boundary conditions (e.g. river flow, tides wind, etc) and in-situ data for comparison, (e.g. water surface elevation, currents, salinity, etc.).

2.5. With the amount of data available, it should be possible to perform a comprehensive calibration and validation analysis, to two different and distinct time periods.

3. Grid questions and comments

3.1. There are three different ROMS model domains discussed in the report without any indication of why this was done.

3.2. For a comprehensive understanding of the bay it would seem that a single larger domain would be more instructive of interaction between the various portions of the Bay. A single domain would also facilitate impact assessment of load from the NBC facilities on other parts of the Bay, which is the focus of the present modeling work.

3.3. Of the three grids, two were the focus of the report; the Providence River grid and the Seekonk River grid. Using the smaller domains of these more focused grids may suffer from the problem of having the open boundaries too close to the study area. For the Seekonk River grid model boundary conditions at Conimicut may overly influence the Providence River in the Fields Point area. Similarly for the Providence River grid the southern open boundaries are at the North end of Prudence Island and will certainly impact upper bay and lower River areas, not allowing the model to predict the response.

3.4. At the northern extent of the Providence River grid the domain terminates at the Narrows leading into the Seekonk River and does not include any allowance for the Seekonk tidal prism. It can be assumed then that the flow through the Narrows is not represented and that therefore flows to the northern extent of the Providence River are also not well represented. The Seekonk River must be represented in the Providence River grid in some manner.

4. Calibration questions and comments

4.1. Tidal open boundary conditions developed from larger domain ADCIRC model application. Why not use real tidal time series data for time period of model-data comparison?

4.2. No comparison to surface elevation was made. Surfaced elevation is one of the primary indicators of a model's predictive capability and is one of the easier parameters to predict. Modelers often find that if a model can not recreate the surface elevation within the study domain it will not be able to replicate other parameter either, or if it does, it often does so for the wrong reasons.

4.3. Some discussion of tidal harmonic constituents presented without any data or comparison to model predictions.

4.4. Velocity comparison looks good. Linear regression analysis appears to show good fit.

4.5. Volume flux determined from ADCP measurements at key boundaries to the Providence rivers but not compared to model predictions.

4.6. A harmonic analysis of the tides and of the currents will help the calibration effort and may help to understand the issue that the model appears to be having with the M4 constituent. Similarly a power spectral analysis of both the tides and the currents will help interpretation of the model predictions.

4.7. Vertical sections for the ADCP current data transects were presented, but no comparisons to model predictions were made. Visual comparison can be made for speed and direction contours or current vectors at various depths along the transect.

4.8. A comparison or at least some presentation of the spatial distribution of currents and salinity, (e.g. current vectors and salinity contours on the map) would be

helpful. At present there is really no indication of whether the circulation patters are being well predicted.

4.9. Too much time is spent discussing the calibration effort and the various simulations and parameter adjustments. This is of interest to the student but not of particular interest to the reviewer. The more standard practice is to select the modelers "best fit" set of coefficients, develop the calibration statistics etc. and subsequently perform a sensitivity study to the various calibration and input parameters.

4.10. Additional statistics should be developed for all of the key hydrographic parameters for a variety of averaging periods (e.g. 1hr and daily average) that would cover the processes of interest:

- surface elevation
- current speed and direction
- volume flux at transects
- salinity
- temperature

4.11. A standard set of statistical measures should be employed, for example:

- min, mean, max
- percentiles
- root mean square error
- error coefficient of variation (RMS/mean)
- regression analysis

5. Summary remarks

5.1. The model application and calibration as reviewed appears to be a good beginning but has some potentially serious issues in terms of acceptability for predictive purposes by the regulatory agencies:

5.1.1. Multiple grid systems for the same water body
5.1.2. Issues with the grids as they were used
5.1.3. Lack of a rigorous calibration
5.1.4. No verification presented

5.2. First and foremost, the grid issue needs to be resolved. With the present setup, the model will have limited use.

5.3. The presentation of the data is somewhat confusing in that the first part of the report appears to be a data report, but that data does not appear to be used. Rather, an entirely different data set, (or data sets) were actually used in comparison to the model predictions.

5.4. Model to data comparisons that were presented look reasonable qualitatively but only a single quantitative statistical comparison was given. Additional statistical comparisons need to be presented to develop what is essentially a weight of evidence for model predictive capability.

5.5. A great deal of confidence in the model and its application to the Providence River and Upper Narragansett Bay could be gained by performing a rigorous calibration and validation exercise. In that exercise the model would be calibrated to one data set, and validated on a separate and distinct data set. For the validation simulation, no variation of the model parameters would be made, only the input boundary conditions would be altered, to reflect the new time period. In that way concrete evidence for the predictive capabilities of the model can be developed. There appears to be enough data to perform this study.