James Chlorophyll Study- Update

by

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Presented in the modeling Quarterly review meeting October 3, 2012
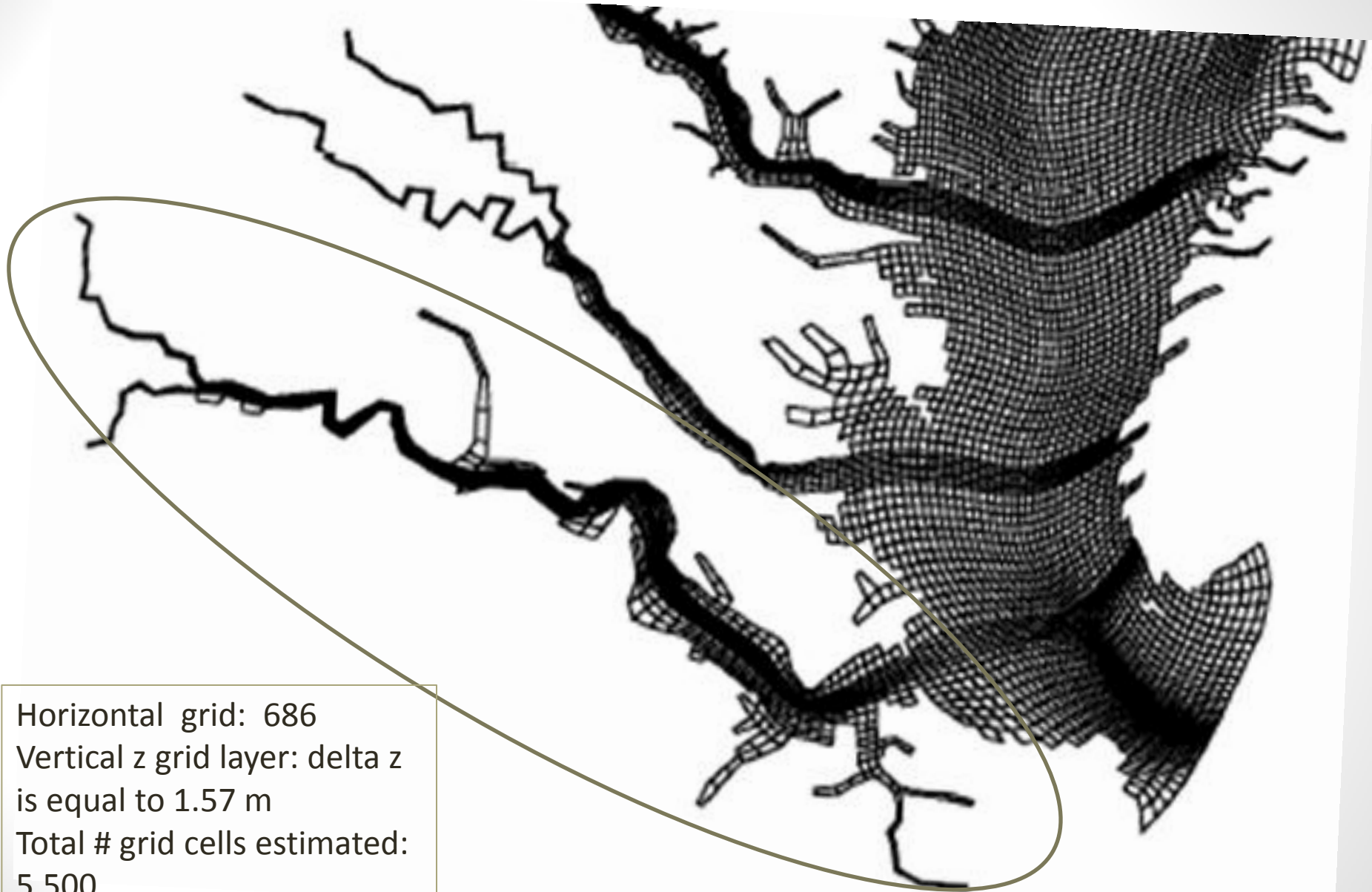
Outline

- CH3D and EFDC modeling grids in the James River

- The open boundary condition at the overlapping zone in the downstream portion of the James River

- Required coupling parameters and protocol for coupling

- Future plans
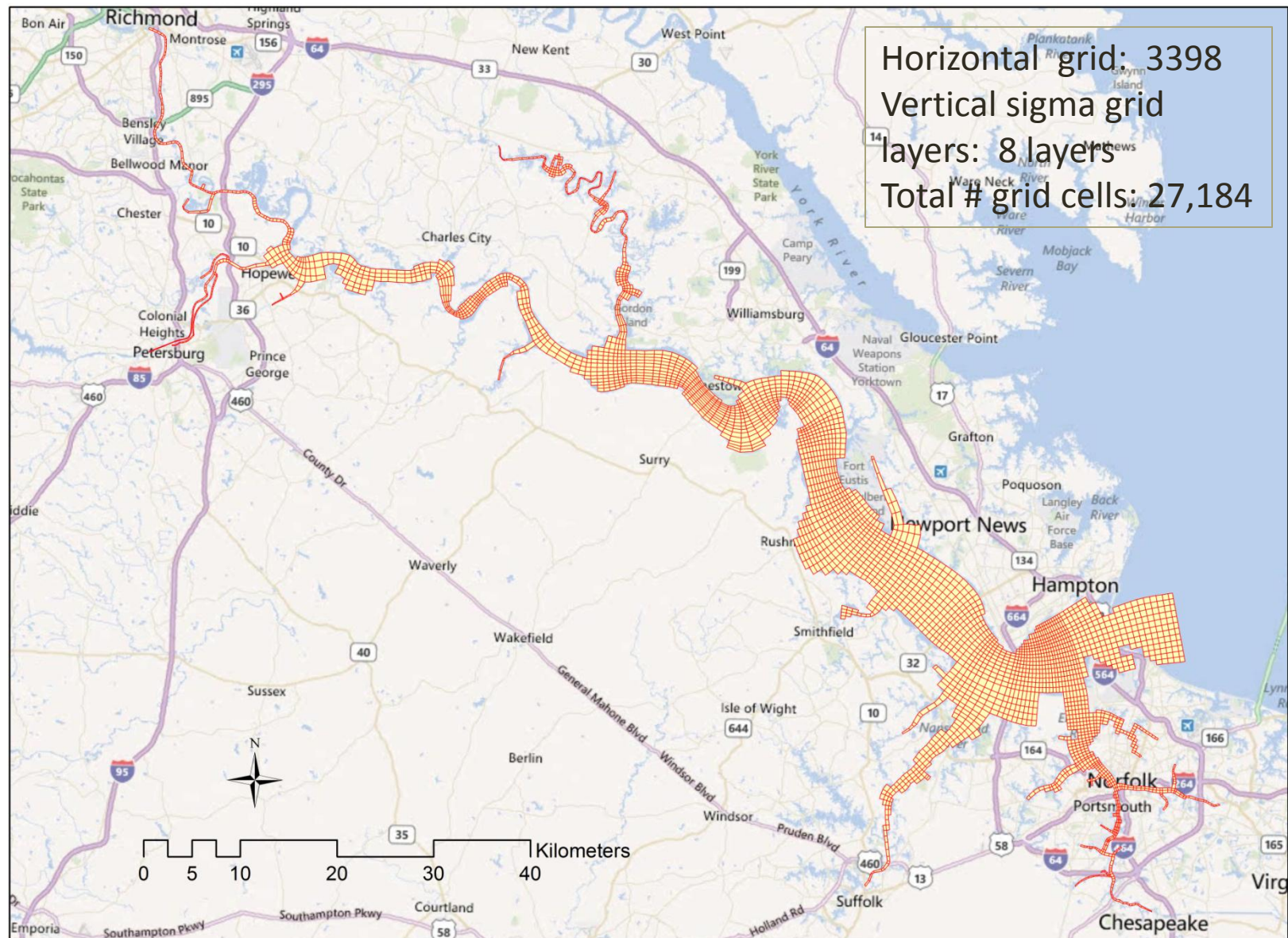
The existing Chesapeake Bay
CH3D model 50,000 grid

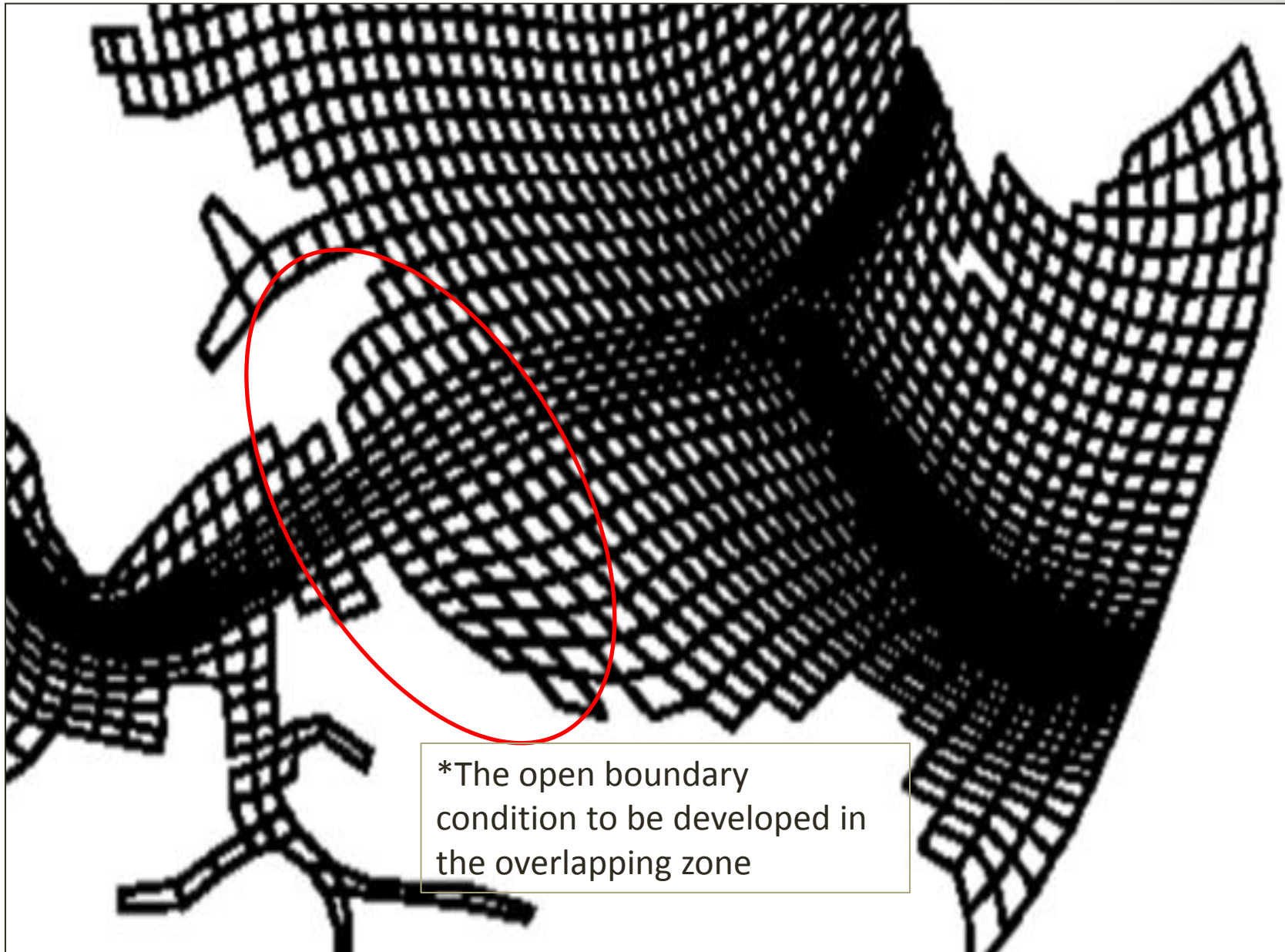Figure 1. Plan view of 50,000-cell CH3D Chesapeake Bay grid.
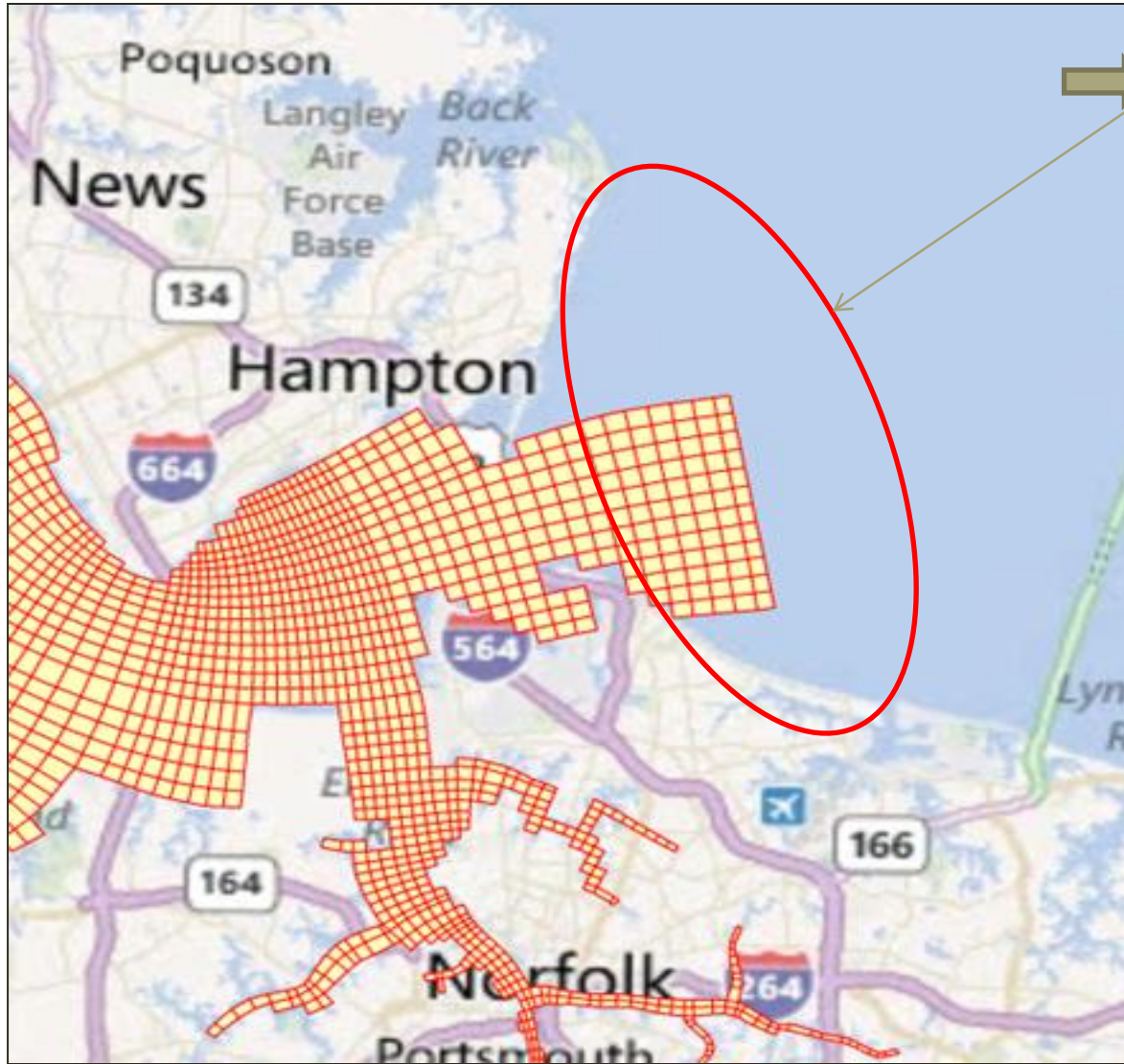
James River portion of CH3D grid

Horizontal grid: 686
Vertical z grid layer: delta z is equal to 1.57 m
Total # grid cells estimated: 5,500

James River grid

Horizontal grid: 3398
Vertical sigma grid
layers: 8 layers
Total # grid cells: 27,184

*The open boundary condition to be developed in the overlapping zone

* See details in the next slides

The open boundary condition is to be developed in the overlapping zone such that the James River hydrodynamic and water quality modeling can be coupled with the bay-wide CH3D/ CE-QUAL-ICM models.

The coupling of water quality parameters I

The EFDC (Environmental Fluid Dynamic Code) hydrodynamic model will be used to drive two water quality model codes:

I.   *HEM3D (Hydrodynamic Eutrophication Model 3D based on ICM) for 1991-2000*
II. *RCA (HDR|HydroQual's 3D WQ model (http://www.hydroqual.com/wr_rca.html) for 2007-2010 during which the high resolution HAB monitor data are available*

HEM3D model water quality state variables

(1) Cyanobacteria

(2) Diatom algae

(3) Green algae

(4) Refractory particulate organic carbon

(5) Labile particulate organic carbon

(6) Dissolved organic carbon

(7) Refractory particulate organic phosphorus

(8) Labile particulate organic phosphorus

(9) Dissolved organic phosphorus

(10) Total phosphate

(11) Refractory particulate organic nitrogen

(12) labile particulate organic nitrogen

(13) dissolved organic nitrogen

(14) ammonia nitrogen

(15) nitrate nitrogen

(16) particulate biogenic silica

(17) dissolved available silica

(18) chemical oxygen demand

(19) dissolved oxygen

(20) salinity

(21) temperature

(22) TSS

The coupling of water quality parameters II

Current RCA model water quality state variables

(1) Algal Group 1

(2) Algal Group 2

(3) Algal Group 3

(4) Refractory particulate organic carbon

(5) Labile particulate organic carbon

(6)Refractory dissolved organic carbon

(7) Labile dissolved organic carbon

(8) Refractory particulate organic phosphorus

(9)Labile particulate organic phosphorus

(10) Refractory dissolved organic phosphorus

(10)Labile dissolved organic phosphorus

(12)Total phosphate

(13)Refractory particulate organic nitrogen

(14) Labile particulate organic nitrogen

(15) Refractory dissolved organic nitrogen

(16) Labile dissolved organic nitrogen

(17) Total ammonium nitrogen

(18)nitrate nitrogen

(19)particulate biogenic silica

(20)dissolved available silica

(21) chemical oxygen demand

(22)dissolved oxygen

(23)salinity

(24)TSS

Require daily or tidally-averaged concentrations for each of the above parameters at the open boundary at 2-3 locations across the mouth of the James River and at 4-6 standard levels or fixed depths for the period 1990-2000 and 2006-2010. Final details or protocols will be determined after consultation with the USEPA/USACE.

The coupling of the physical transport

Table: EFDC model hydrodynamic state variables

(1) u, v, w velocity fields in 3D   (2) water level η

(3) salinity   (4) temperature

(5) TSS

→ **Require u, v (no w) flow, η, salinity, temperature, TSS at the open boundary for 4-6 standard levels or fixed depths in the vertical at 2-3 locations across the width of the James River boundary, every ½ hour for the period 1990-2000 and 2006-2010**

Future plans

- Complete testing of the coupling of EFDC with RCA for the James River model grid
- Couple EFDC, HEM3D and RCA with Tetra-Tech's modified watershed model for the James River watershed
- Develop empirical and deterministic HAB models for the freshwater and marine portions of the James River