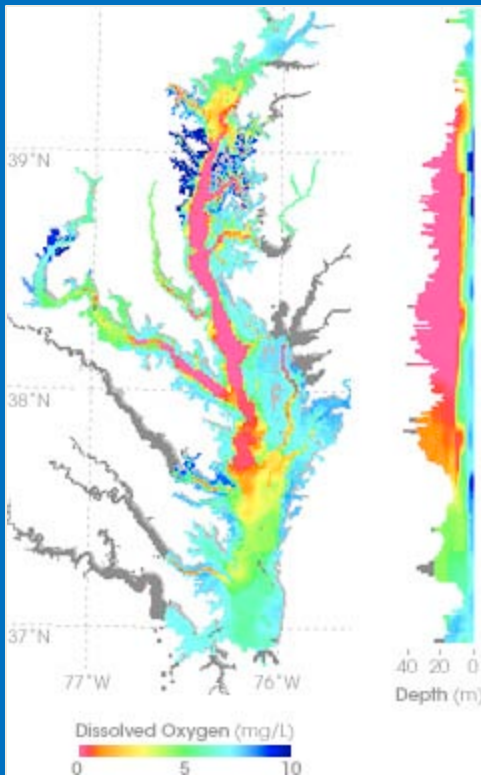
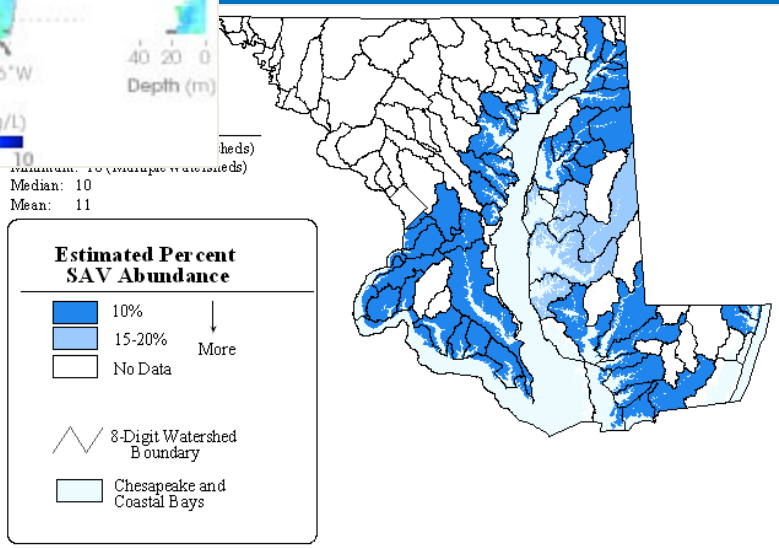


Changing Emphases

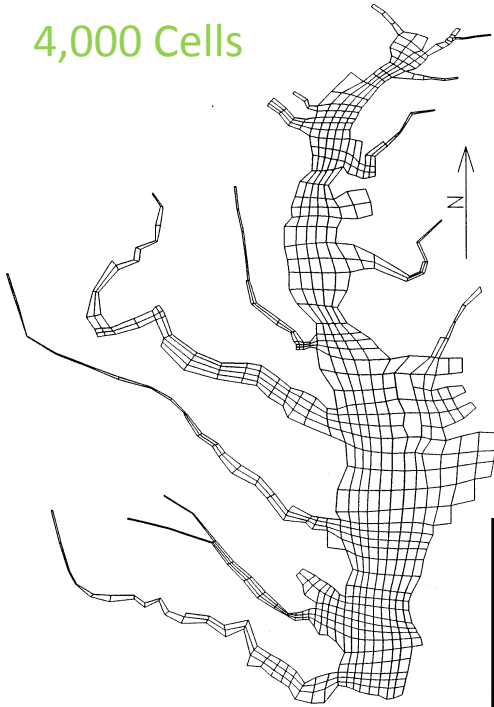


- Almost since its inception, emphasis by the EPA Bay Program has been moving up the tributaries and into shallow water.
- In response, the resolution of the CBEMP has increased by an order of magnitude, from 4,000 to 50,000 cells.
- Minimum depth represented on the grid has decreased from 3.7 m to 2 m.



- Circa 1983 – Focus on hypoxia in the deep trench of the bay and major tributaries.
- 2010 – Focus on shallow water and living resources. Water clarity and SAV are especially important.

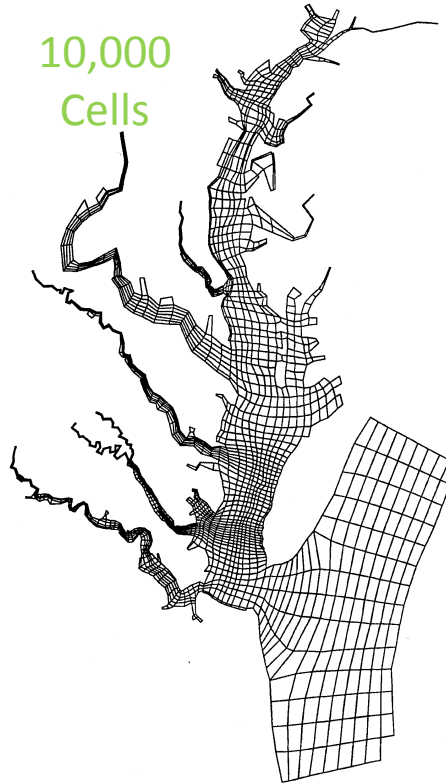
4,000 Cells



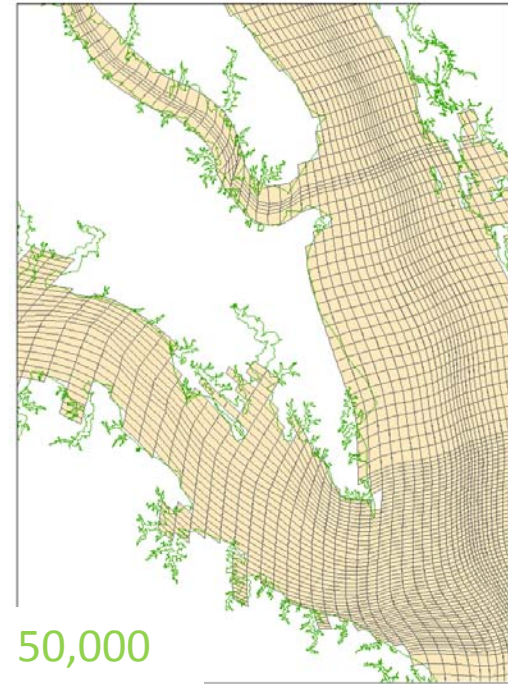
12,000 Cells



10,000 Cells



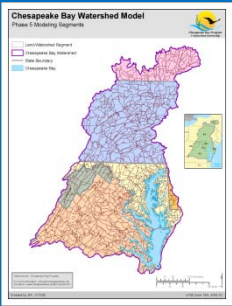
50,000 Cells



Multiple
Model
Grids



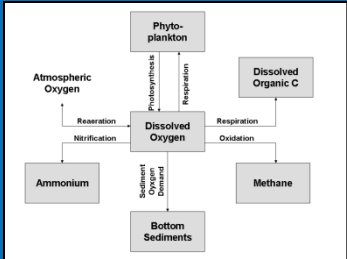
Regional Atmospheric Deposition Model



Watershed Model

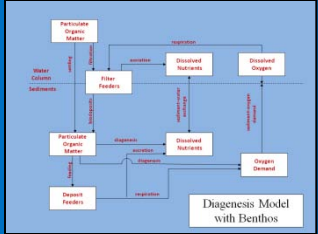
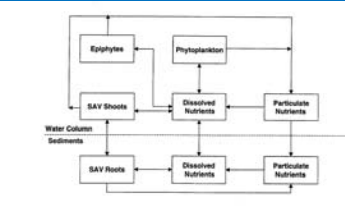
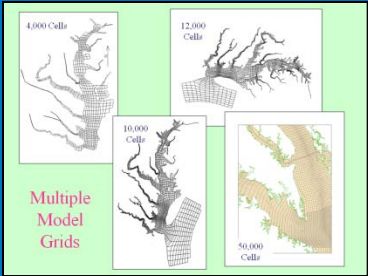
Hydrodynamic Model

Eutrophication Model



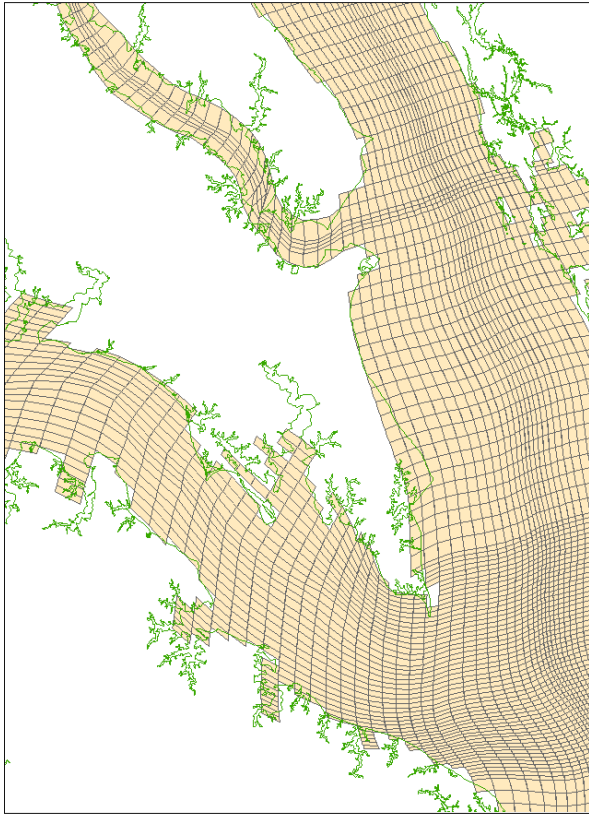
SAV Component

Benthos Component



The CBEMP

We've Hit the Limit with CH3D

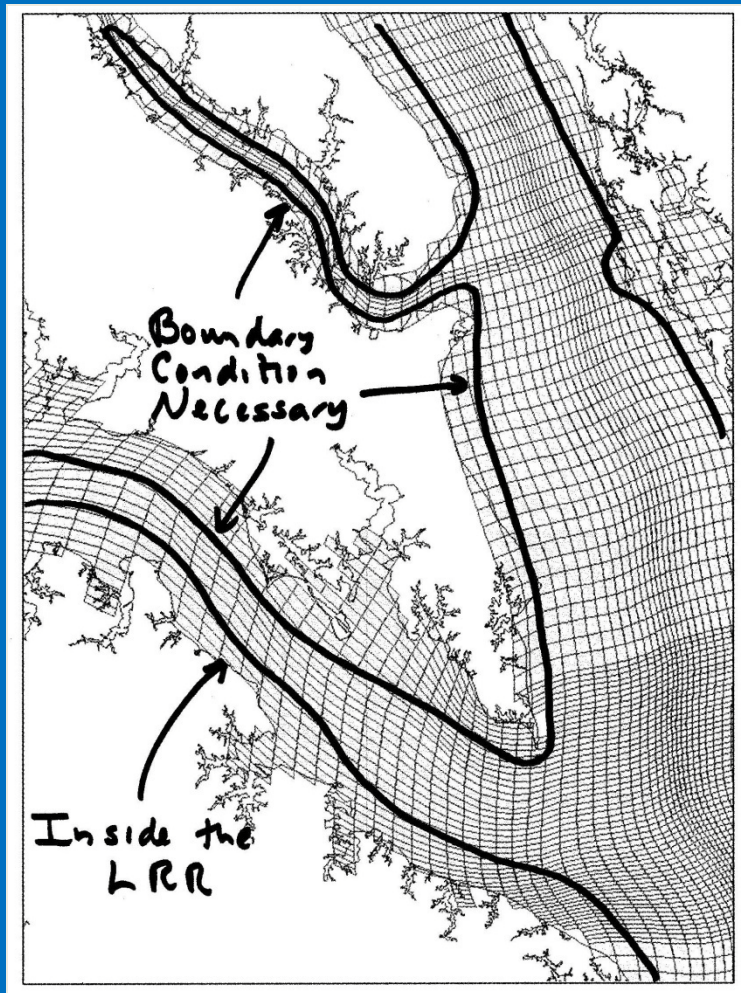


- The present grid consists of 50,000 cells $\approx 1,000 \text{ m} \times 250 \text{ m} \times 2 \text{ m}$
- Difficult to fit shoreline with quadrilateral cells.
- Problems with increasing resolution in shallow water while resolving entire bay from head to mouth.
- No wetting and drying (dynamic adaptation to shoreline).

Solution: The Living Resource Ribbon Model (LRRM)

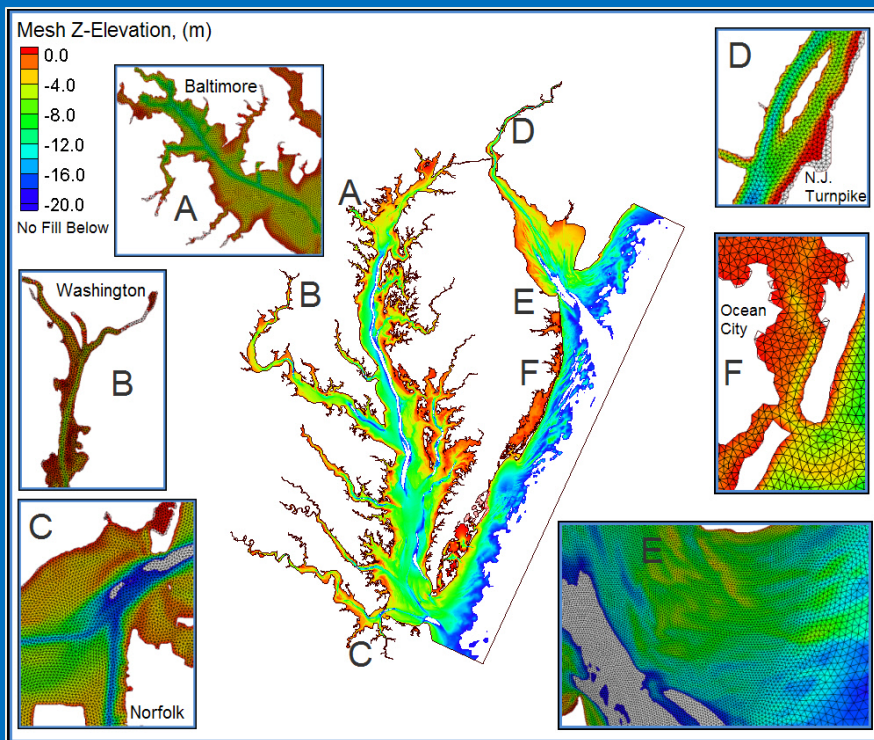
- Model only the area between the shoreline and the 2 or 3 m contour.
- Interface with existing model (or an alternate) for deeper water.
- Retain existing water column kinetics.
- Renewed focus on shallow water processes:
 - Wetting and drying.
 - Wetlands.
 - Suspended solids.
 - SAV.

Challenges



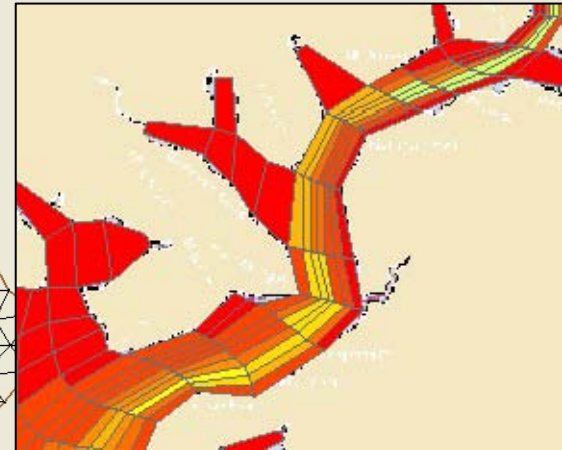
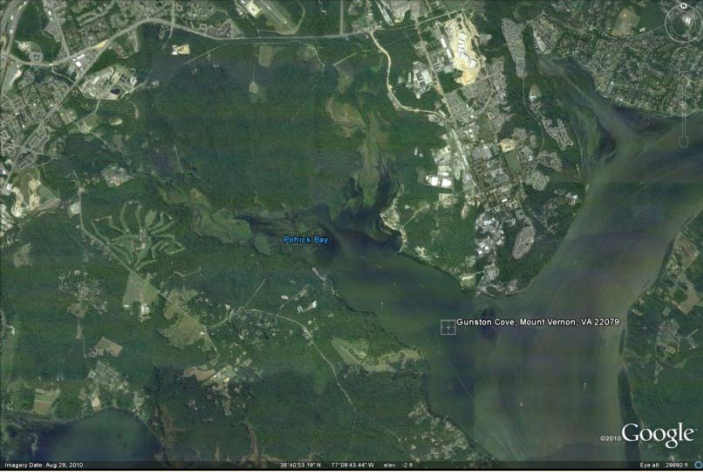
- Can we run the LRRM alone? What model or algorithms will provide forcing along the open boundary?
- Will we run into computational or other problems along the lengthy open boundary?
- Another option is to run one system-wide hydrodynamic model with emphasis in shallow water.

Hydrodynamic Model Options – ADH



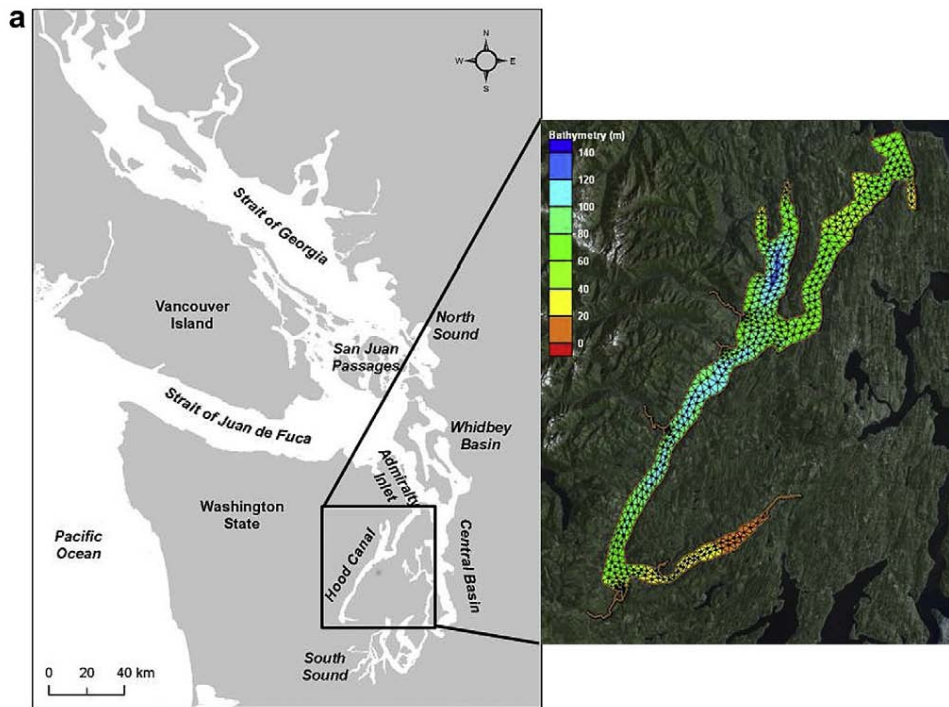
- Unstructured grid, mass balance at nodes.
- Triangular mesh conforms to complicated shorelines.
- Wetting and drying.
- Initial application to Chesapeake Bay commenced.
- Coupling to ICM commenced.

Element count = 1,065,811
Node count = 560,770
Bay element size = 220m edges,
area = 22,160 sq-m



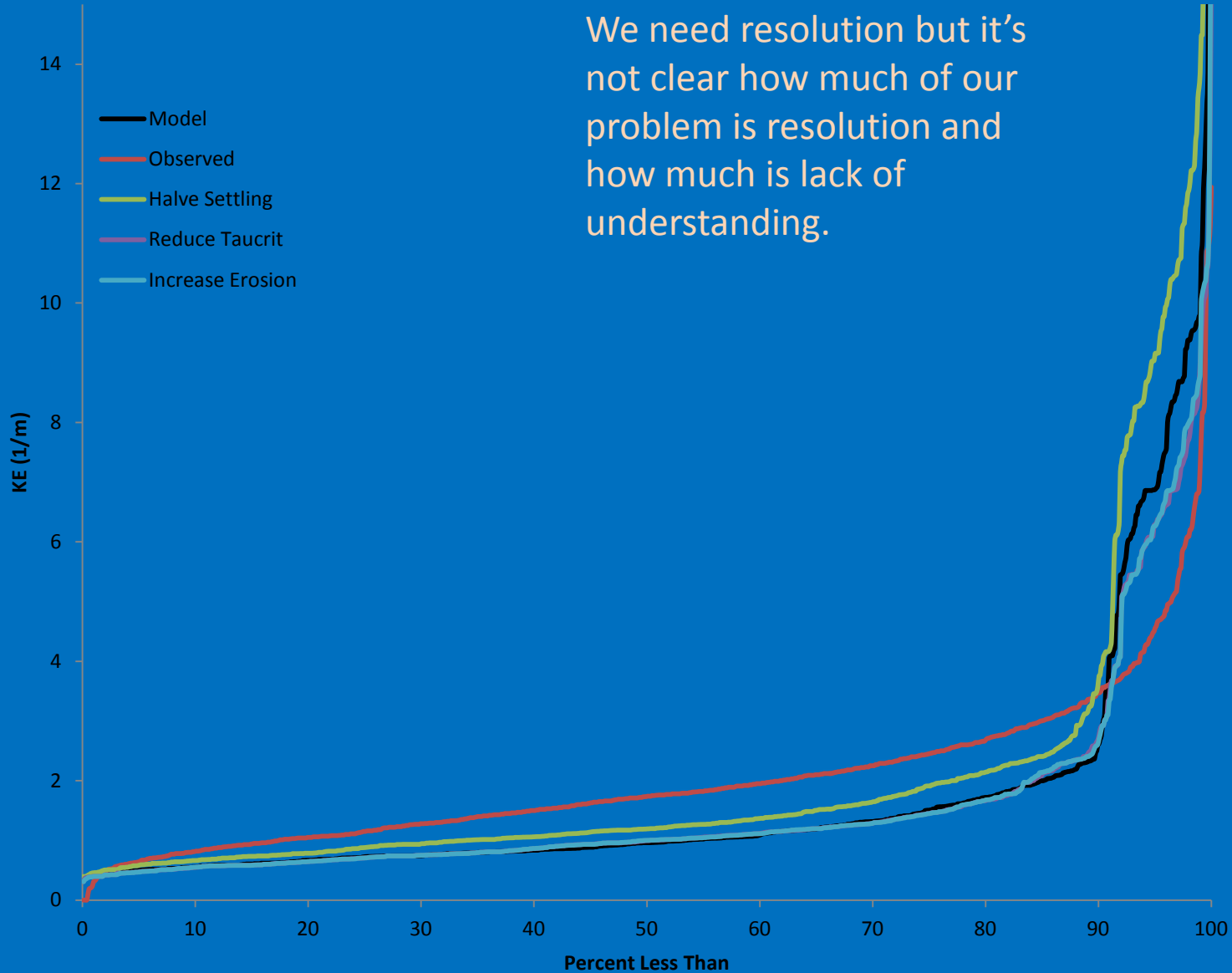
Hydrodynamic Model Options – FV-COM

T. Kim, T. Khangaonkar / *Environmental Modelling & Software* 31 (2012) 47–63



- Unstructured grid, mass balance in volumes.
- Triangular mesh conforms to complicated shorelines.
- Wetting and drying.

We need resolution but it's not clear how much of our problem is resolution and how much is lack of understanding.

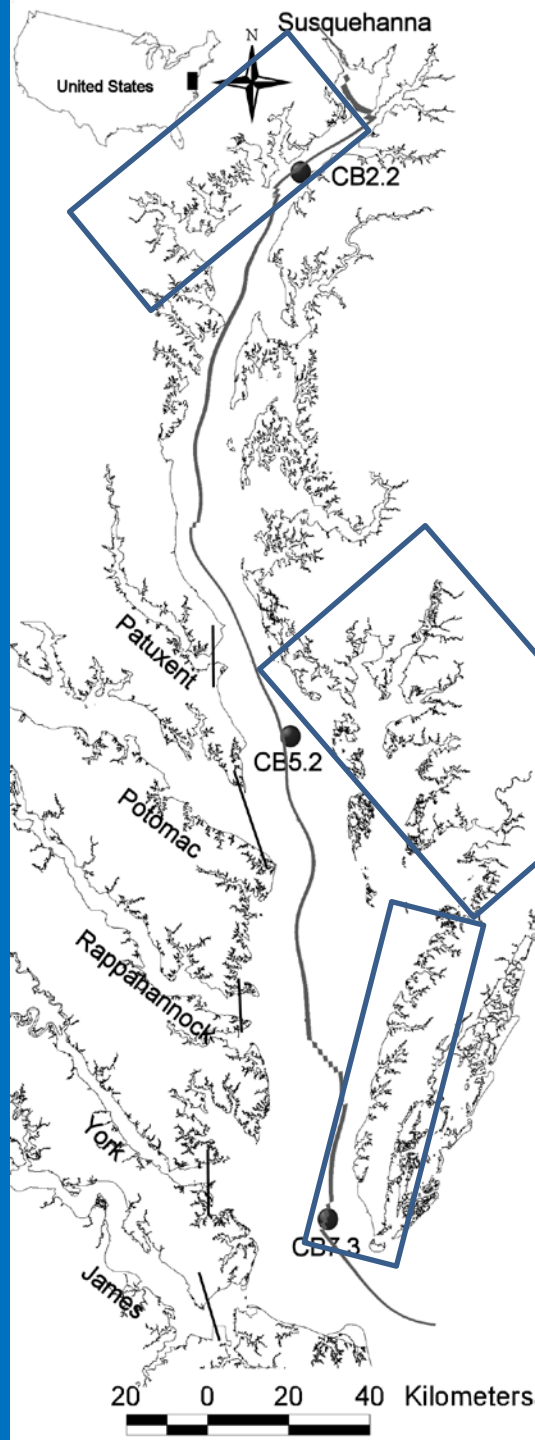


Overview

- Revised model ready to go by December 2015
- Reassessment of Phase III Watershed Implementation Plans in 2017
- Retain present CH3D/ICM for the mainstem bay and open-water regions
 - They are operational and function well
 - Replacement with a different model configuration will likely entail recalibration, software development etc.
- Emphasize development of a separate shallow-water model that will interface with CH3D/ICM
 - The Living Resource Ribbon out to 3m depth contour
 - Propose to employ the Corps' ADH model with ICM

The Living Resource Ribbon

- Divide the bay system into shoreline reaches for application of LRR
 - Efficiency is enhanced if we don't do the entire bay shoreline in one application
 - Do our reaches encompass the entire bay shoreline or fewer regions of high interest?
 - How does a reach like the upper James River fit into the ribbon concept?
- Apply to Multiple Reaches
 - Are regional calibrations feasible? Resource and data constraints.
 - What is the data extent? Do we have data in reaches and sub-reaches? If not, is it worth calibrating?
 - Shallow-water monitoring data
 - Application period



- Can we do the entire bay shoreline in one ribbon?
- If not, how many reaches do we attempt?
- The number of shallow water embayments is fractal. How many do we try to calibrate?
- What to do about embayments/reaches where there is no data?
- Should we focus in on a couple of high-importance/problem areas?

Wetlands and Shallow Water Component

- Empirical or simplified models of wetland processes
 - Respiration, nutrient exchange, burial of solids, nutrients
- Beach and Shoreline Processes
 - Resuspension of solids and POC?
 - Shoreline erosion
 - Revisit waves in small creeks?
 - Interface with LRR model, bay model
- Optical modeling

Oysters and Menhaden

- Examine their role on the present grid
 - Calibration
 - Allocation conditions
 - Compare to previous calculations. Determine differences, if any, and their origins
- Oysters and the Living Resource Ribbon
 - Do we incorporate oysters in the LRR model?
 - Update reef location and biomass
 - The previous work was all about restoration to historic distribution
 - Role of aquaculture

The Living Resource Ribbon

- Select one or two initial areas for test of concept, feasibility
 - Gunston Cove or Gunpowder River
 - Test ADH/ICM package currently under development
 - Develop software links to CH3D, ICM, WSM
 - Flux or concentration boundary conditions?
 - Sediment resuspension
 - Submerged aquatic vegetation
 - Benthic algae
 - Resuspension of POC, PON, POP