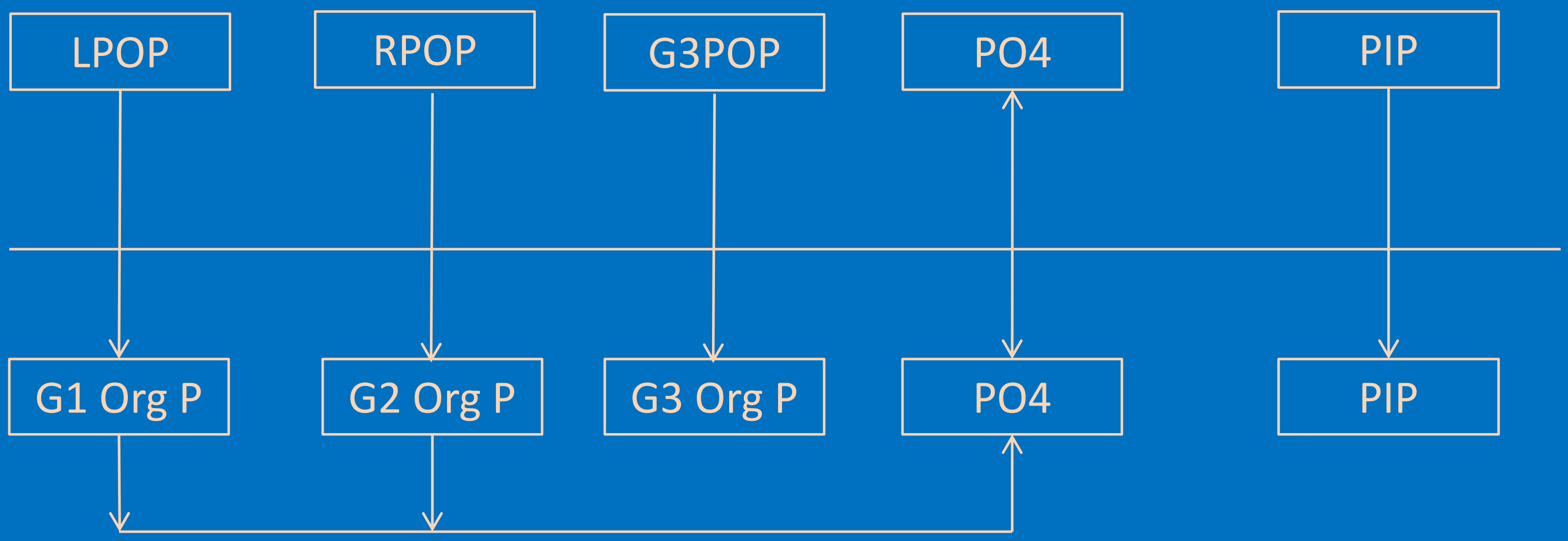
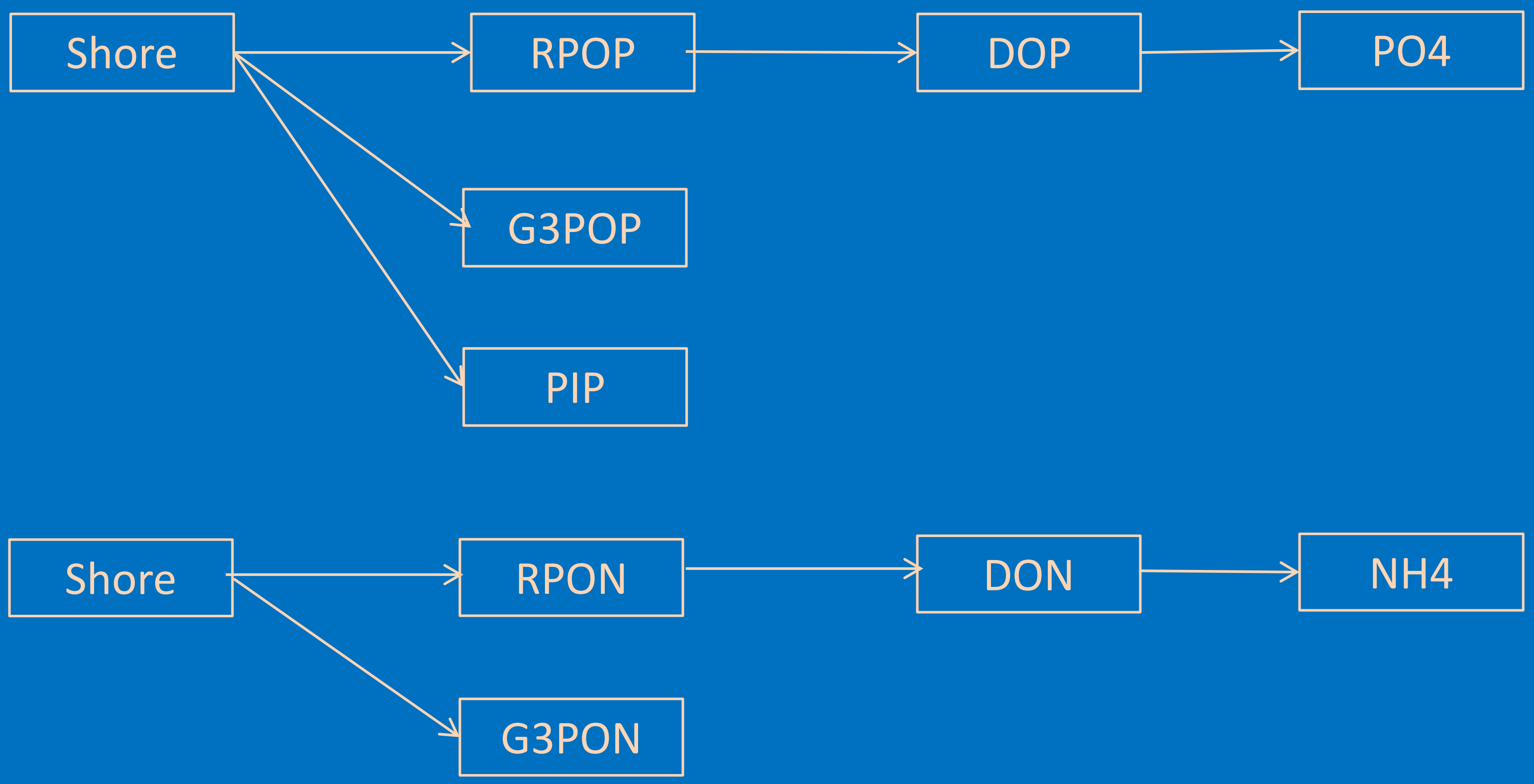
Incorporation of G1, G2, G3 Organic Matter

Revised Routing of Water Column P to Sediments



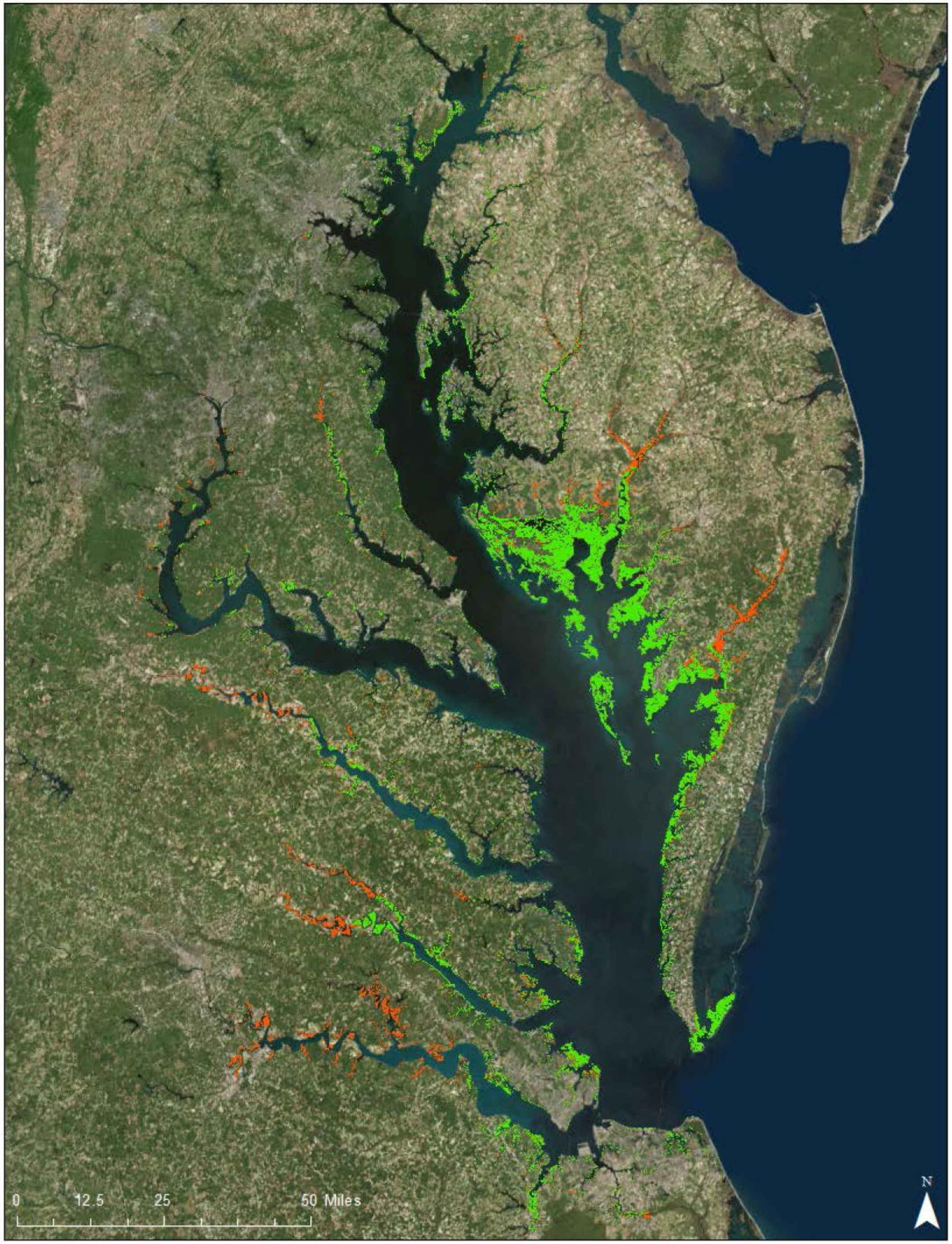
Revised Routing of Shoreline Erosion Loads to Water Column



What's Missing?

- Data to assign G1, G2, G3 splits to loads.
- Right now, splits are assigned to keep the amounts of reactive material similar to previous (2010) calibration.
- Laboratory studies are underway to examine reactivity of material in Conowingo sediments. Available sometime in 2016.
- Model studies are proposed to improve predictions of reactivity of loads at Conowingo spillway. Available March 2016?
- Laboratory studies are proposed to examine reactivity of eroding wetlands material. Available December 2016?
- We may have to individually calibrate G2, G3 properties (e.g. settling rates) to adjust model to new loads, other factors.
- Revisions to PIP calibration and parameterization may be warranted.

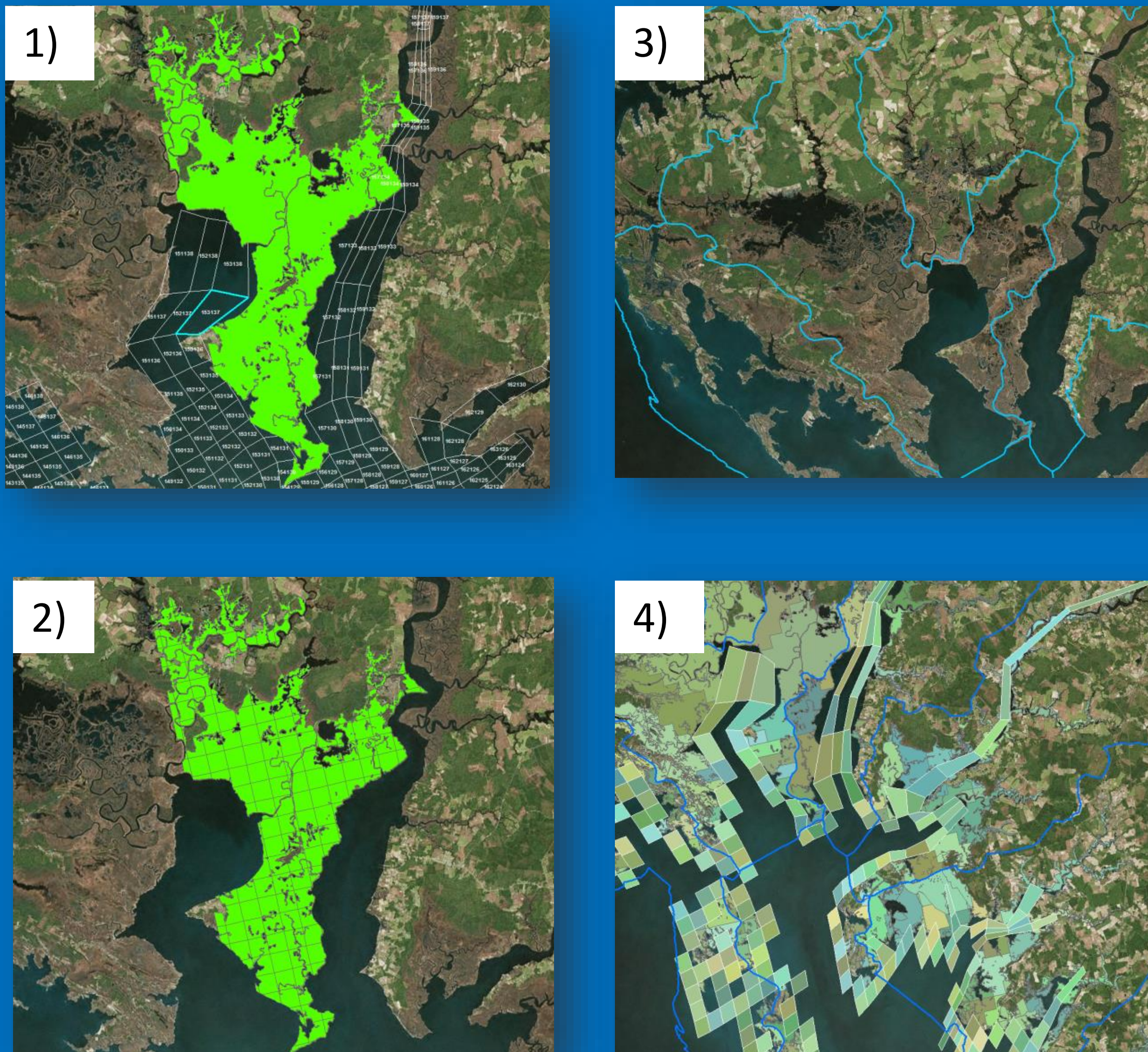
Wetland Nutrient Attenuation and Wetland Loss



Chesapeake Bay Tidal Wetlands

- Extent from National Wetlands Inventory.
- Determined largely from vegetation perceived via aerial photography.
- 190,000 hectares of estuarine (green) and tidal fresh (red) wetlands.
- Shape files provided by Quentin Stubbs and Peter Claggett, EPA Chesapeake Bay Program.

Assign Wetlands Areas to Model Cells



1. Wetlands polygon.
2. Divide polygon into "fishnet."
3. Overlay 10-digit HUC boundaries.
4. Assign wetlands areas to model cells based on proximity and local watershed boundaries.
5. Thank you, Scott Bourne, ERDC.

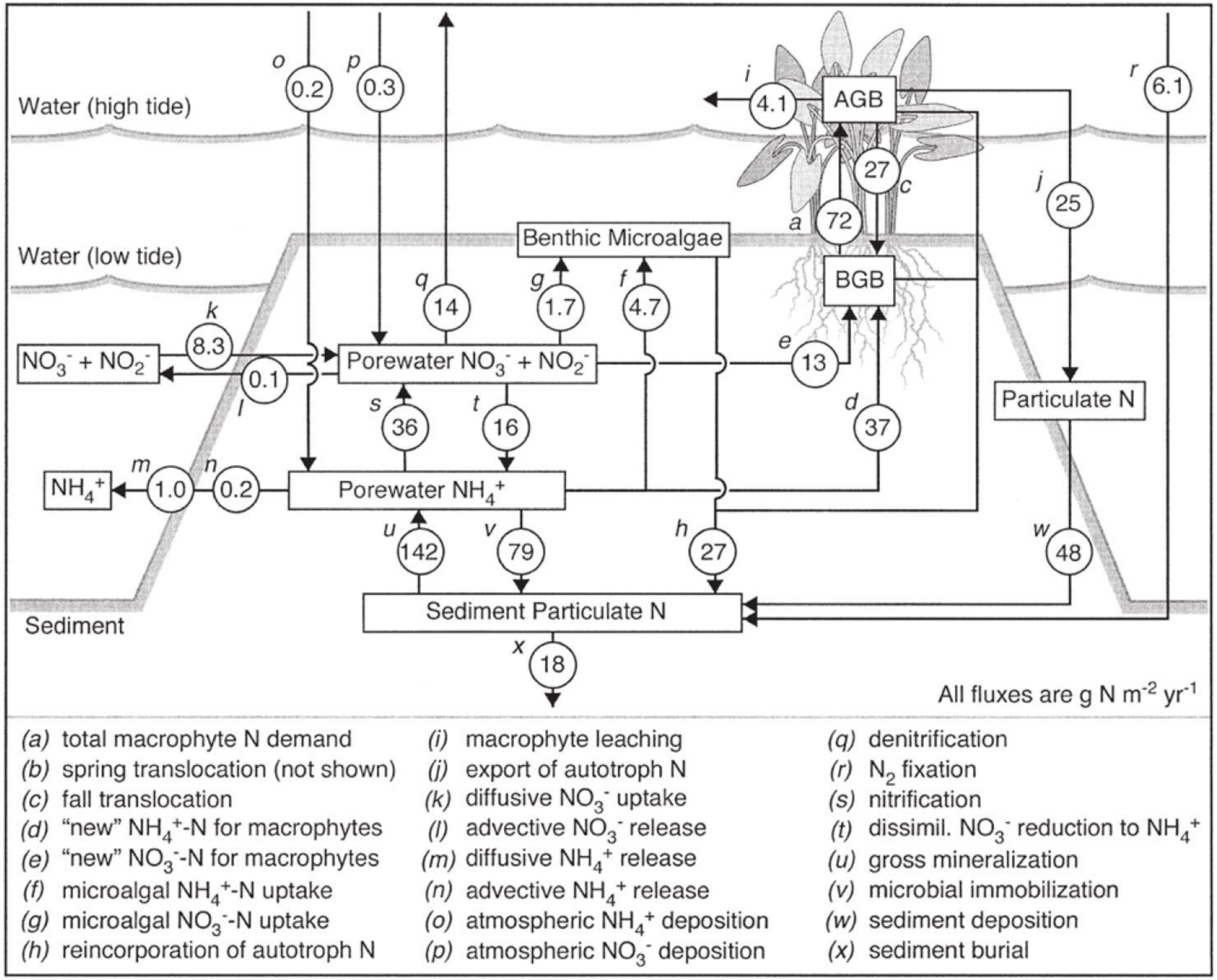


Fig. 3. Nitrogen mass balance for Sweet Hall marsh. All fluxes are in $g\ N\ m^{-2}\ yr^{-1}$ and are based on measured rates, literature values, or calculated by difference (assuming steady state) as detailed in the text. Standard deviations for each flux are omitted for visual clarity but can be found in Table 1 and in the text. AGB = aboveground macrophyte biomass; BGB = belowground macrophyte biomass.

Estuaries Vol. 28, No. 6, p. 909–922 December 2005

Nitrogen Cycling and Ecosystem Exchanges in a Virginia Tidal Freshwater Marsh

Scott C. Neubauer[1,2]*, Iris C. Anderson[1], and Betty B. Neikirk[1]

Wetlands Module

- We don’t want to develop a complete wetlands biogeochemical model.
- We do want to develop a simplified module that includes:
  - Particle burial (organic and inorganic)
  - Respiration
  - Denitrification
  - Primary production?
  - Others?

$$V \cdot \frac{dC}{dt} = Transport + Kinetics - WSw \cdot C \cdot Aw$$

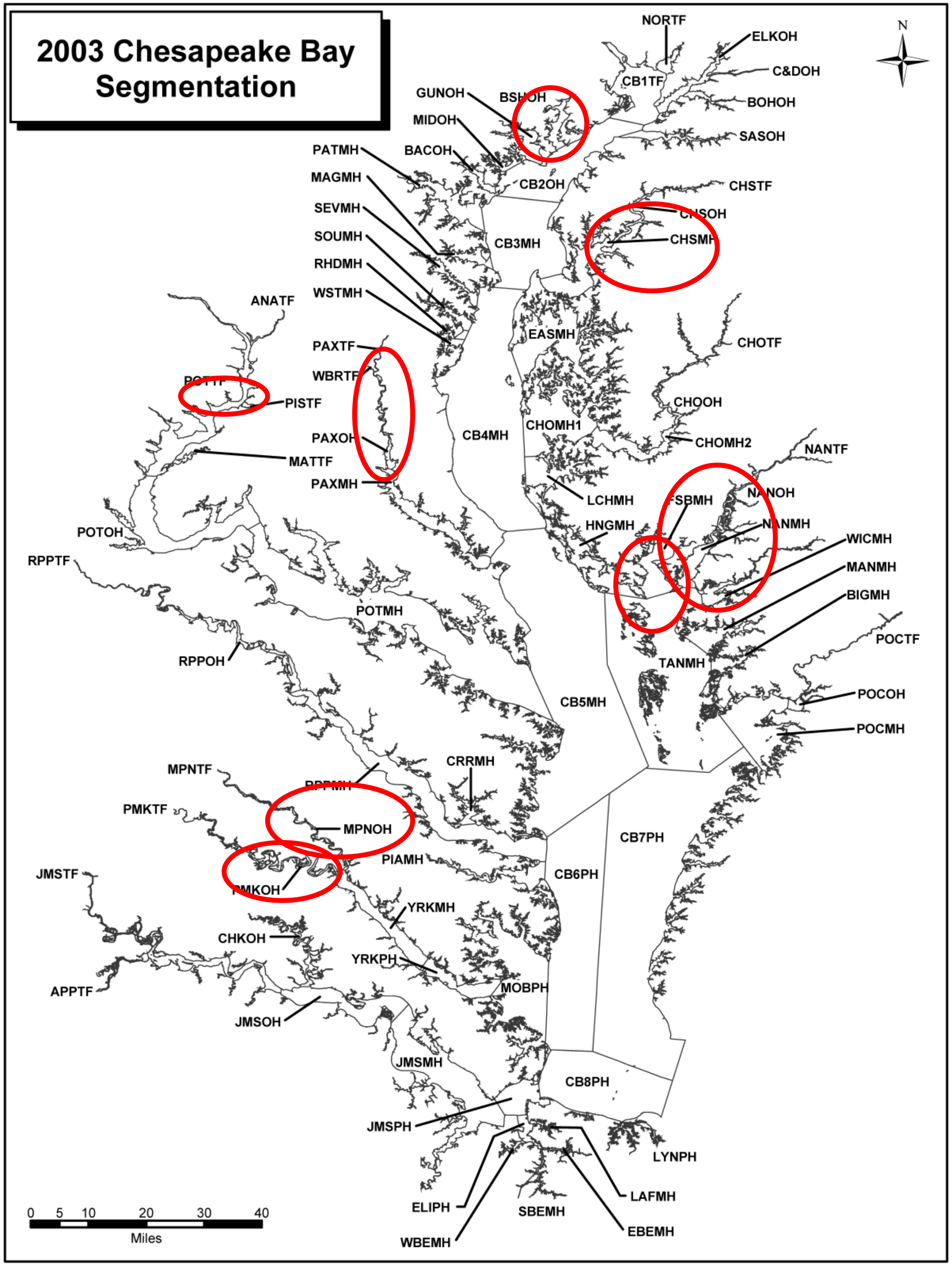
V = volume of WQM cell adjacent to wetlands
C = concentration
WSw = wetland settling velocity
Aw = area of wetland adjacent to WQM cell

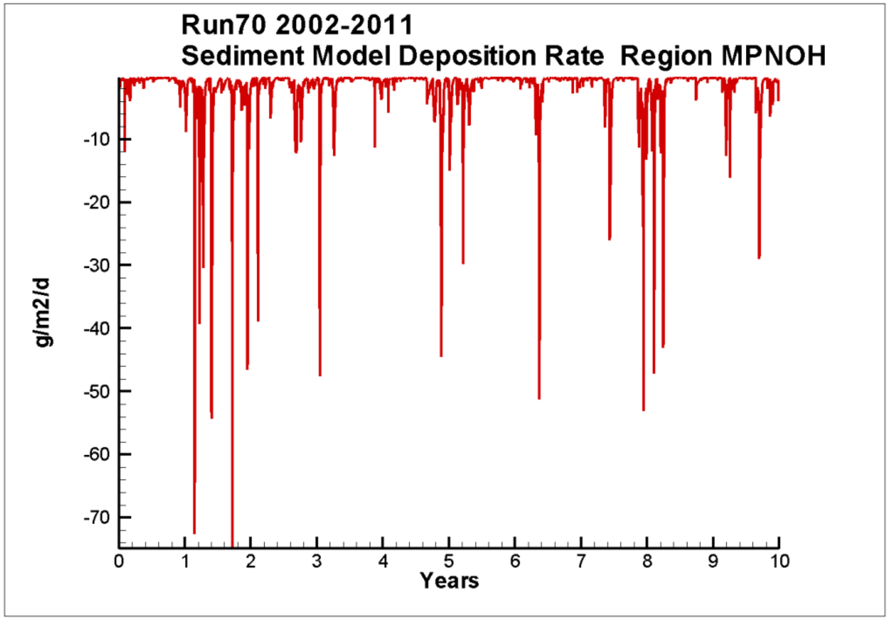
This applies to all particles, organic and inorganic.

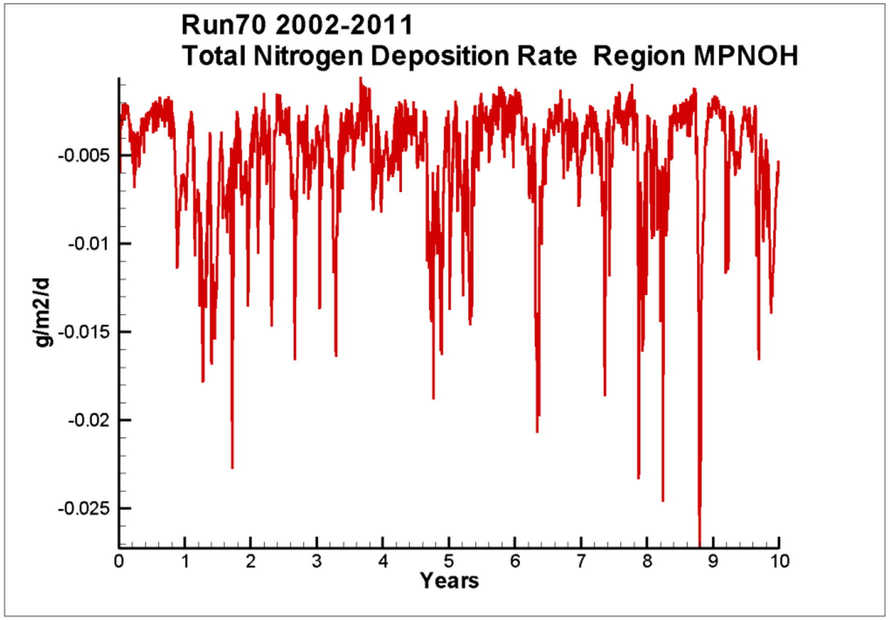
Where Are We Now?

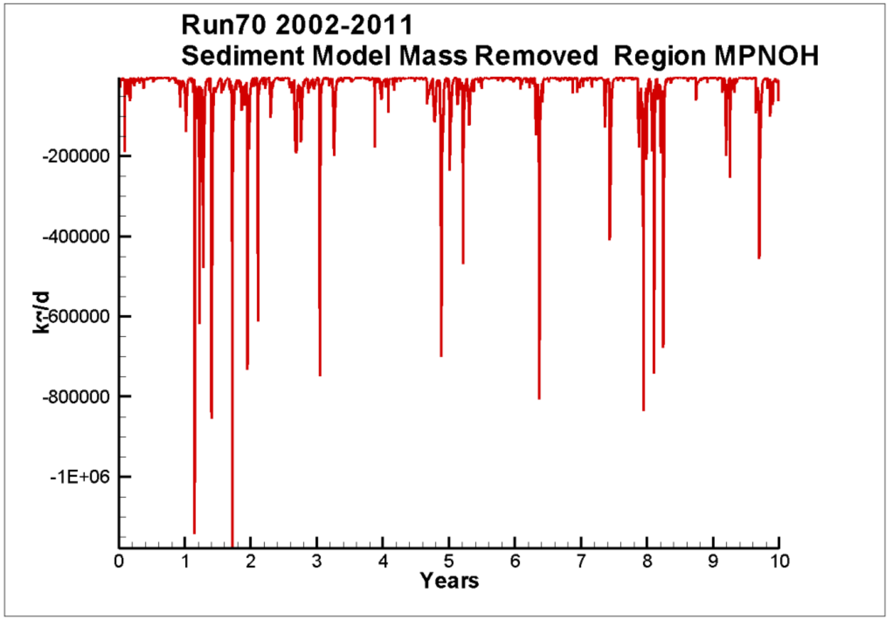
- Particle settling at one tenth the rate through water column.
- Respiration of 1 gm / sq m / d with temperature correction.
- Compared to:
  - No wetlands particle burial
  - Respiration of 3 g /sq m / d, temperature corrected but areas provided for TMDL model.

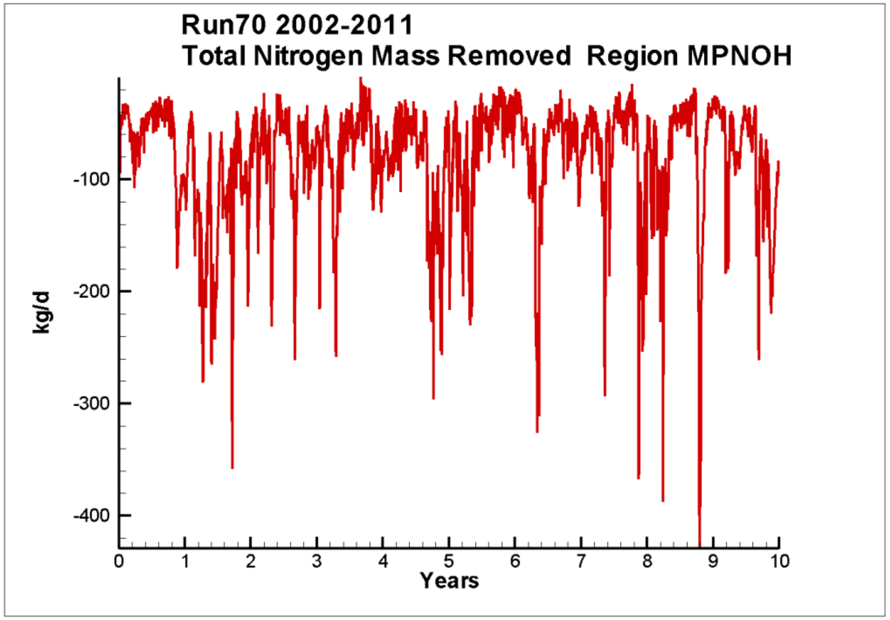
Hot Spots for Calibration




Run70 2002-2011
Sediment Model Deposition Rate Region MPNOH
g/m2/d
-10
-20
-30
-40
-50
-60
-70
0 1 2 3 4 5 6 7 8 9 10
Years


Run70 2002-2011
Total Nitrogen Deposition Rate Region MPNOH
g/m2/d
-0.005
-0.01
-0.015
-0.02
-0.025
0 1 2 3 4 5 6 7 8 9 10
Years


Run70 2002-2011
Sediment Model Mass Removed Region MPNOH
-200000
-400000
-600000
-800000
-1E+06
0 1 2 3 4 5 6 7 8 9 10
Years


Run70 2002-2011
Total Nitrogen Mass Removed Region MPNOH
kg/d
-100
-200
-300
-400
0 1 2 3 4 5 6 7 8 9 10
Years

Oyster Sanctuaries and Aquaculture

What Do We Have?

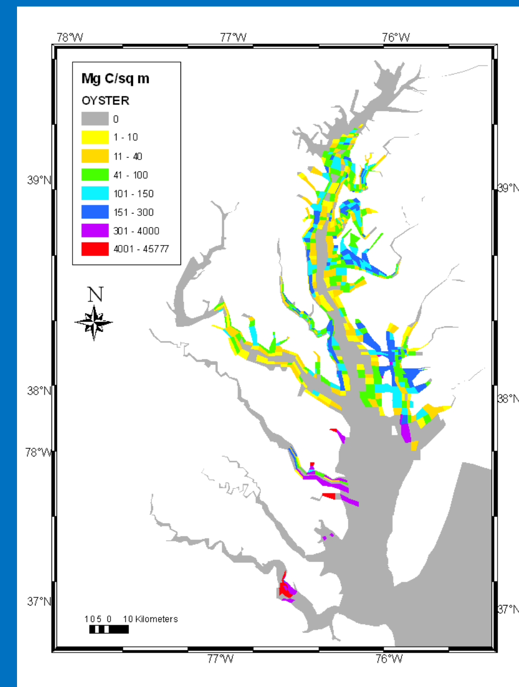
Estuaries and Coasts Vol. 30, No. 2, p. 331–343 April 2007

Can Oyster Restoration Reverse Cultural Eutrophication in Chesapeake Bay?

CARL F. CERCO* and MARK R. NOEL

Mail Stop EP-W, U.S. Army Engineer Research and Development Center, 3909 Halls Ferry Road, Vicksburg, Mississippi 39180

ABSTRACT: We investigated the hypothesis that effects of cultural eutrophication can be reversed through natural resource restoration via addition of an oyster module to a predictive eutrophication model. We explored the potential effects of native oyster restoration on dissolved oxygen (DO), chlorophyll, light attenuation, and submerged aquatic vegetation (SAV) in eutrophic Chesapeake Bay. A tenfold increase in existing oyster biomass is projected to reduce system-wide summer surface chlorophyll by approximately 1 mg m^{-3}, increase summer-average deep-water DO by 0.25 g m^{-3}, add 2100 kg C (20%) to summer SAV biomass, and remove 30,000 kg d^{-1} nitrogen through enhanced denitrification. The influence of oyster restoration on deep extensive pelagic waters is limited. Oyster restoration is recommended as a supplement to nutrient load reduction, not as a substitute.



ERDC/EL TR-14-13

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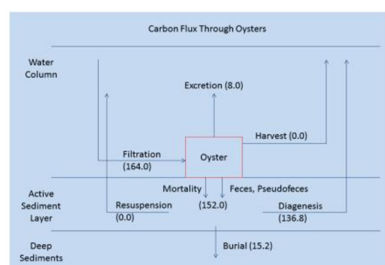
Calculation of Oyster Benefits with a Bioenergetics Model of the Virginia Oyster

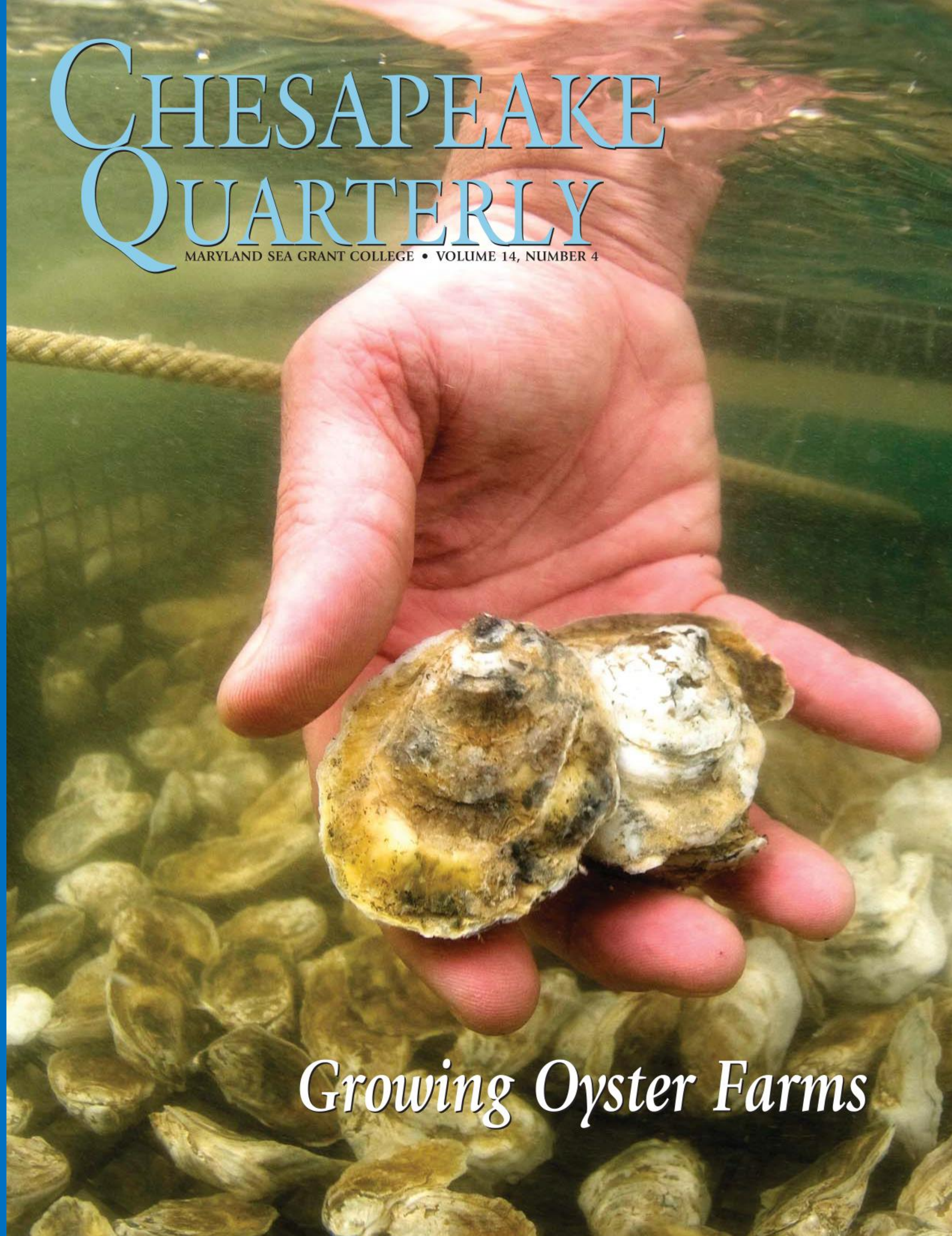
Carl F. Cerco

November 2014



What’s Missing?

- Present oyster biomass and distribution.
- Information on aquaculture (location, methods, harvest).
- Incorporation into present model.
- The 2005 oyster model is operational in the present model.
- We could make projections similar to the effects of a ten-fold biomass increase, using previous biomass estimates.
- Time to obtain more recent information is open-ended.


CHESAPEAKE QUARTERLY
MARYLAND SEA GRANT COLLEGE • VOLUME 14, NUMBER 4
Growing Oyster Farms

Somebody has a lot of information.

Department of Natural Resources.

The industry that's emerged is divided into two distinct camps: those who grow oysters on the bottom and those who grow them off the bottom in cages, bags, or floats. More than 80 percent of the current leases, both new and long-standing, are labeled as bottom leases, and they occupy more than 90 percent of the acres under lease. The largest of these leases is 311 acres and the average size is 14.5 acres — a far cry from those early one-acre leases.

Bottom farming falls into two sub-

Maryland oyster leases by county, October 2015

Lease type	Anne Arundel	Calvert	Charles	Dorchester	Kent	Queen Anne	St. Mary's	Somerset	Talbot	Wicomico	Worcester	Total
Submerged land (SL)	24	11	1	57	1	5	64	24	52	40	10	289
Water column (WC)	2	2	0	19	1	2	22	6	1	0	8	63
Total	26	13	1	76	2	7	86	30	53	40	18	352

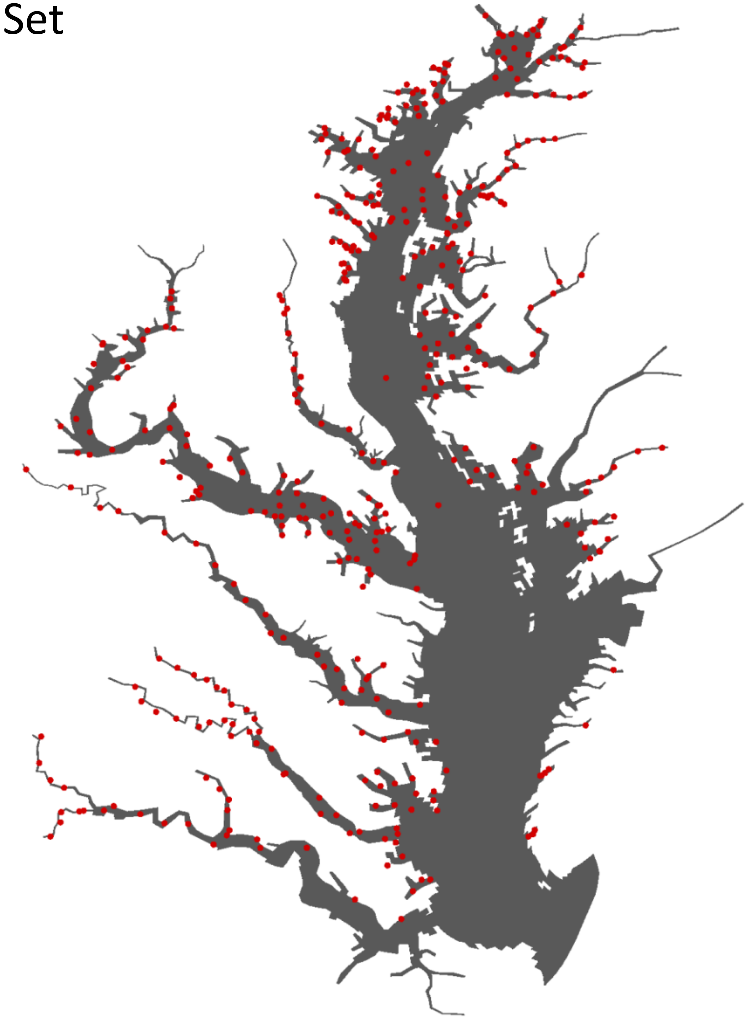
Oyster farmers are trying a variety of high-tech and low-tech *approaches to growing this bivalve in Maryland waters, but the state Department of Natural Resources classifies them in only two categories: Submerged Land Leases (SL) and Water Column Leases (WC). The first category primarily covers on-bottom techniques that feature loose shell to catch natural spat set or plantings of spat-on-shell. The second category covers cages, bags, floats, and any other device that holds oysters off the bottom. As the map shows, the busiest centers for both styles of aquaculture are Dorchester County on the Eastern Shore and St. Mary's County on the western side of the Bay.* TABLE SOURCE: KARL ROSCHER; MAP, CREATED BY SANDY RODGERS ON A BASE MAP FROM VECTORSTOCK.COM

Representation of Shallow-Water Data and Processes

WQSTM Shallow-Water Simulation

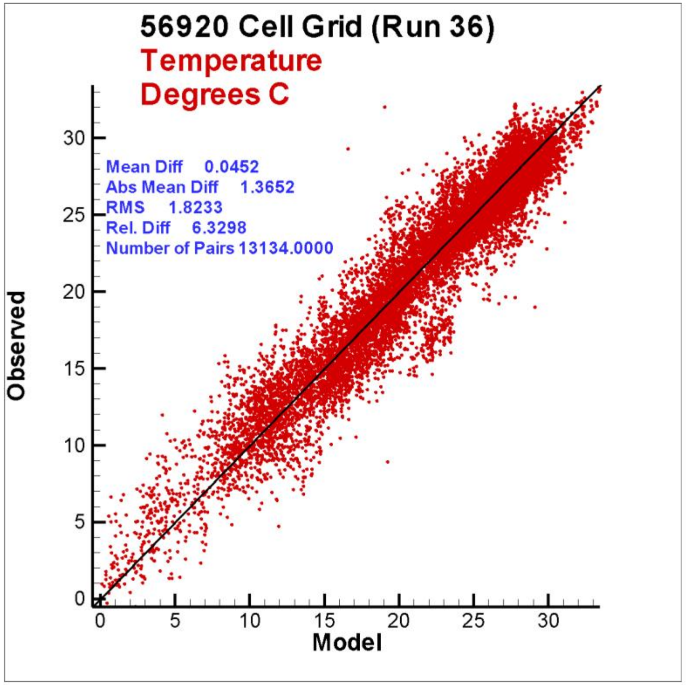
- We received the shallow-water database from CBP circa autumn 2012.
- These are grab samples and measures collected when continuous stations are serviced and coincident with Dataflow cruises.
- More than 750,000 records.
- Roughly 84,000 useful observations.

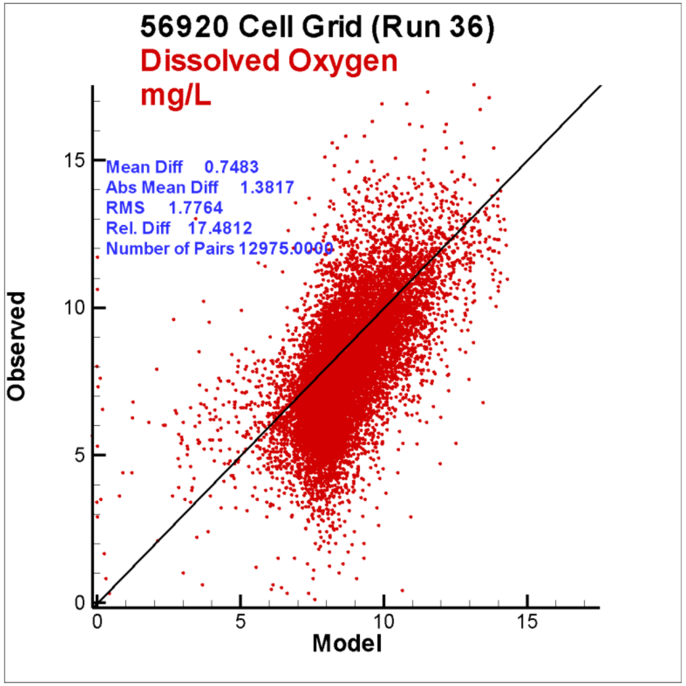
Complete Data Set

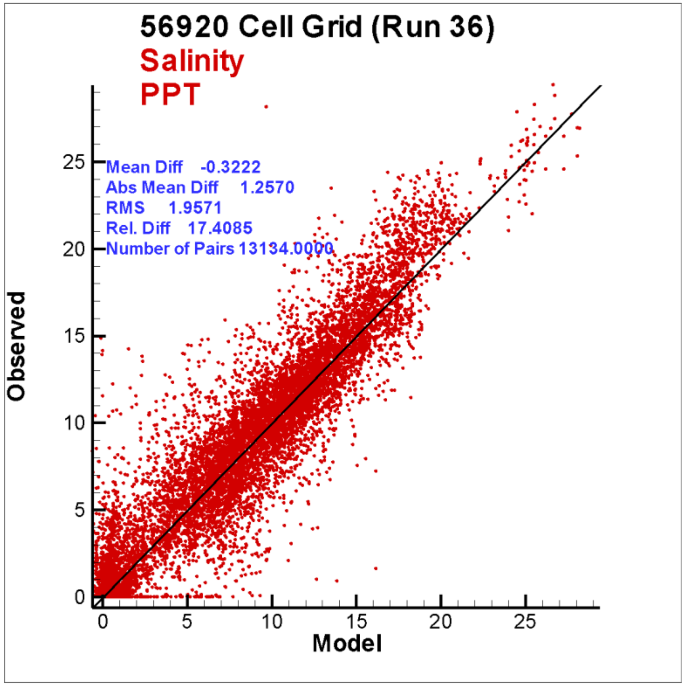


Revised, < 4m deep

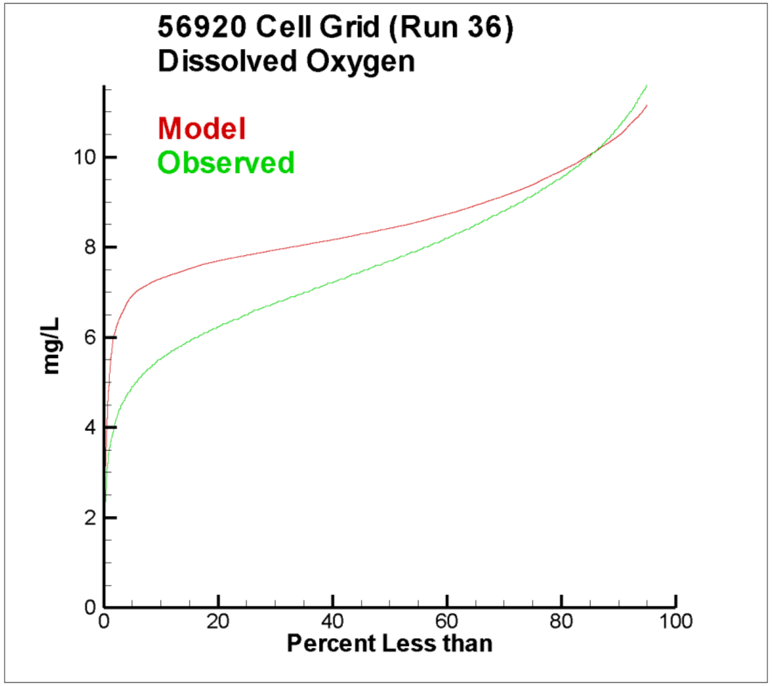
We’re in reasonable agreement with physical quantities such as temperature, salinity, dissolved oxygen.

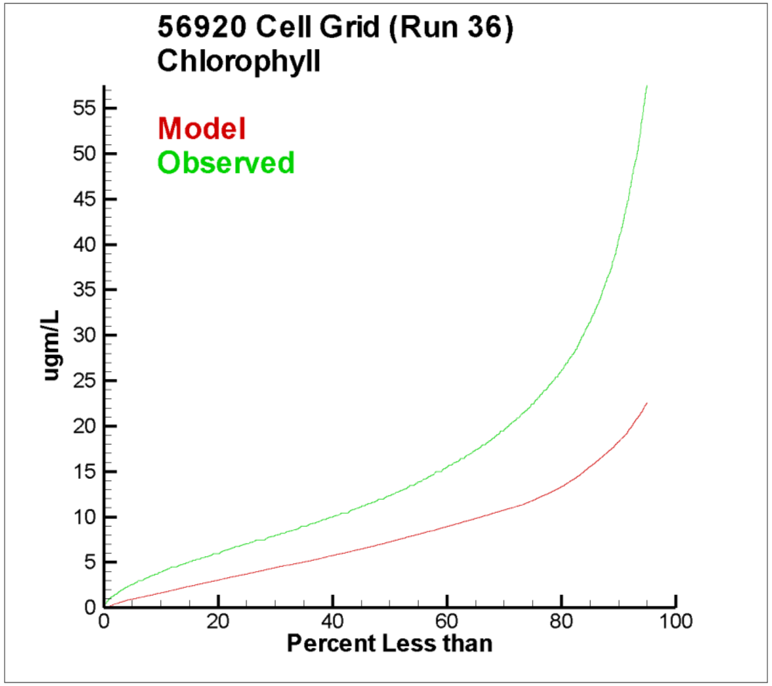


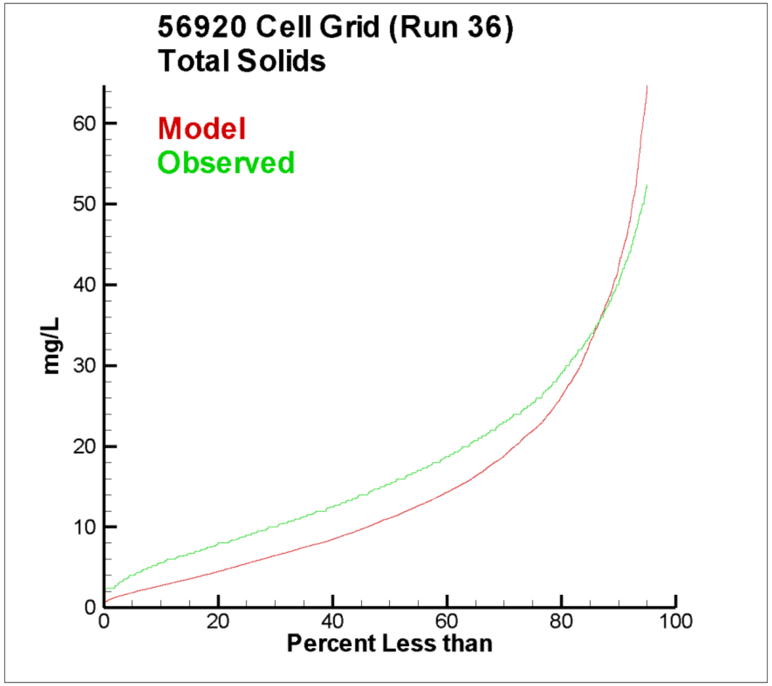


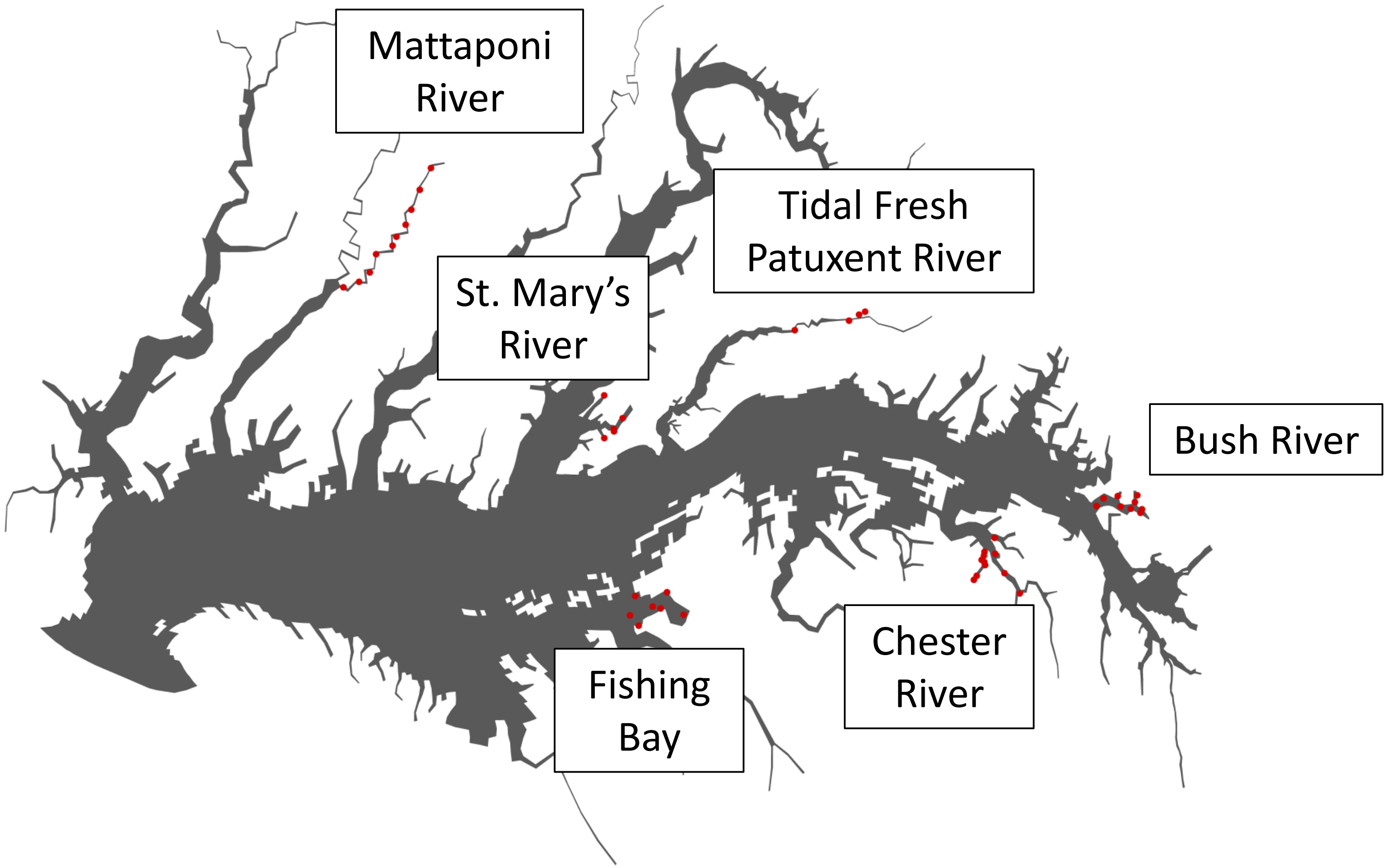


Overall, we tend to be low on chlorophyll, TSS, high on dissolved oxygen.








Mattaponi River
St. Mary's River
Tidal Fresh Patuxent River
Bush River
Fishing Bay
Chester River