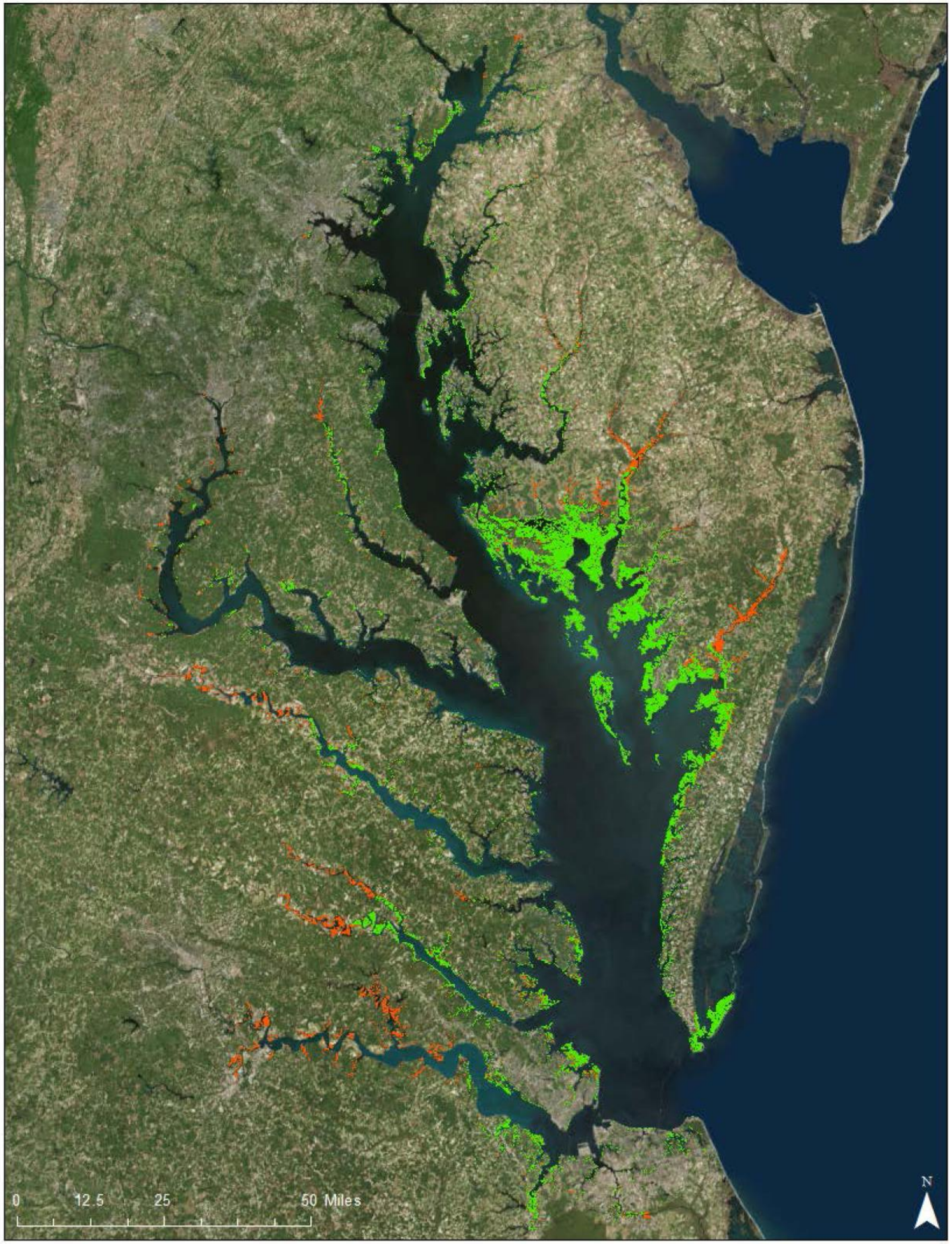
Motivation

1. Assess effect of wetland loss on Bay water quality e.g. solids and organic matter erosion.
2. Assess effect of loss of wetlands function on Bay water quality e.g. diminished denitrification, burial.

What Do We Need?

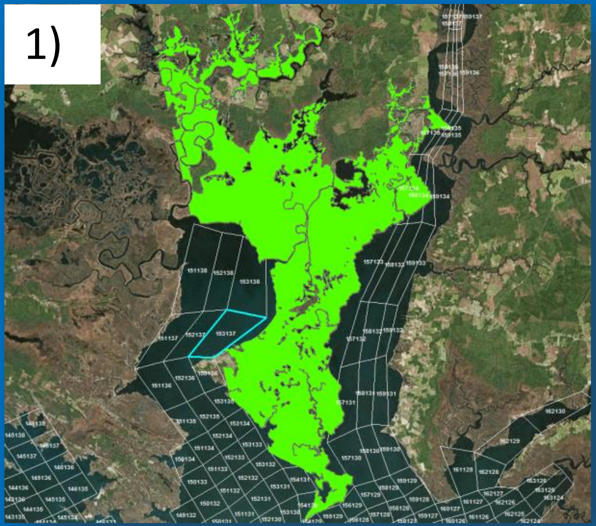
1. Information on current wetland area and type, mapped to Chesapeake Bay computational grid.
2. Projections of future wetland area and type.
3. Information on wetlands function, composition of eroded materials.

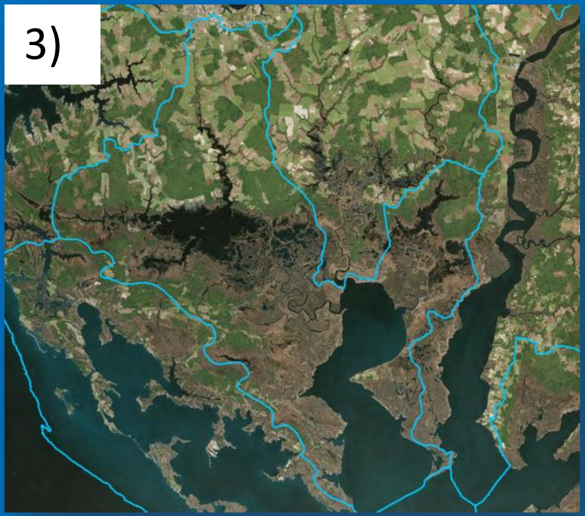


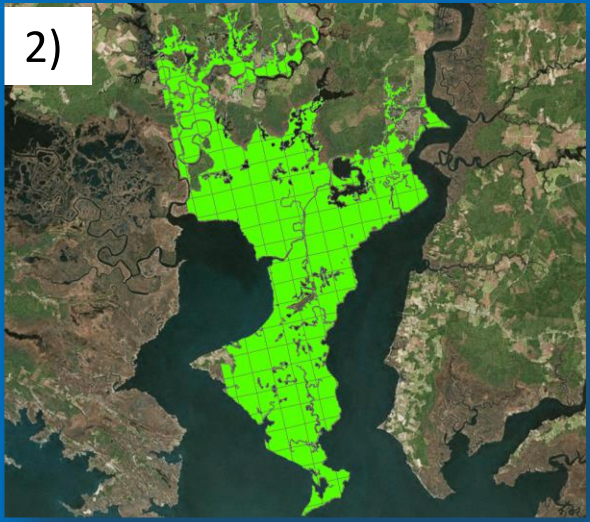
Chesapeake Bay Tidal Wetlands

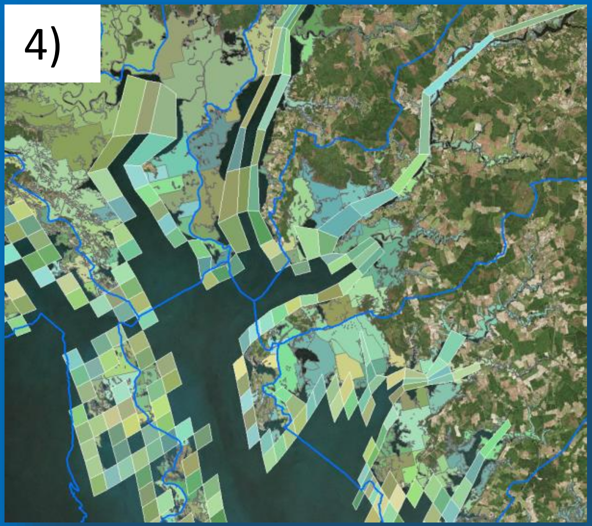
- Extent from National Wetlands Inventory.
- Determined largely from vegetation perceived via aerial photography.
- 190,000 hectares of estuarine (green) and tidal fresh (red) wetlands.
- Shape files provided by Quentin Stubbs and Peter Claggett, EPA Chesapeake Bay Program.

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.

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?

Particle Settling

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

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. Present settling rates 0.05 m/d for most particles, 0.005 m/d for phytoplankton.

Respiration

$$V \cdot \frac{dC}{dt} = Transport\ + Kinetics\ - f(DO) \cdot f(T) \cdot WOC \cdot Aw$$

V = volume of WQM cell adjacent to wetlands
C = concentration
f(DO) = limiting factor = DO/(Kh+DO)
f(T) = temperature effect
WOC = wetland oxygen consumption
Aw = area of wetland adjacent to WQM cell

At present, WOC = 0.5 g DO/sq m/d at 20C. WOC doubles for a 10C temperature increase. Kh = 1.0 g DO/m3.

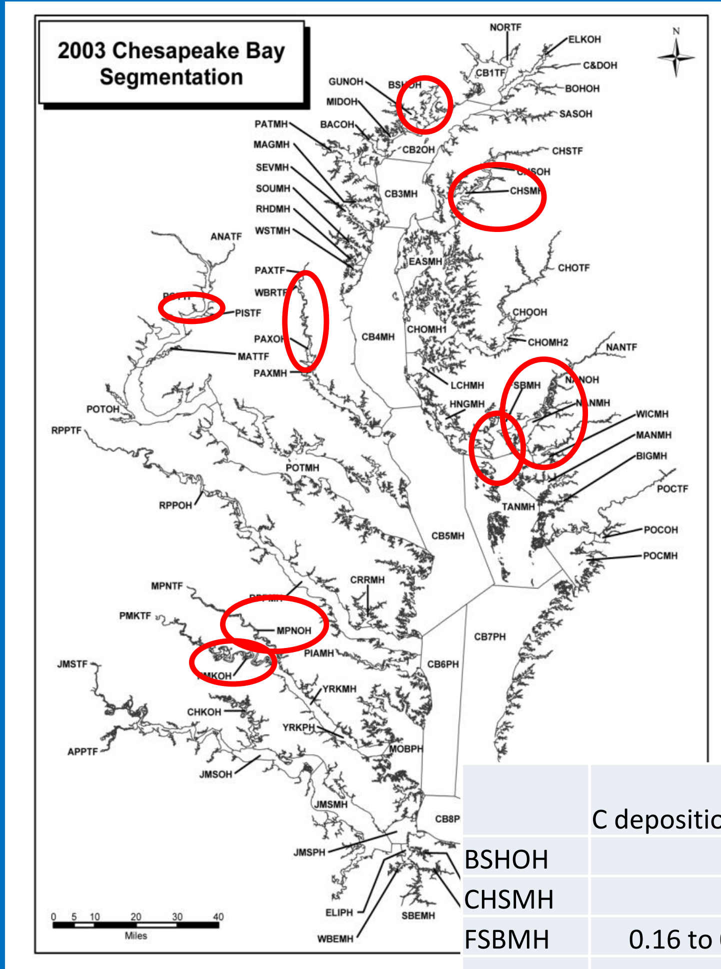
Previous calibration had WOC = 1 g DO/sq m/d and no limiting factor. Wetland areas from TMDL model.

Denitrification

$$V \cdot \frac{dC}{dt} = Transport\ + Kinetics\ - MTC \cdot f(T) \cdot C \cdot Aw$$

V = volume of WQM cell adjacent to wetlands
C = nitrate concentration
MTC = mass-transfer coefficient
f(T) = temperature effect
Aw = area of wetland adjacent to WQM cell

At present, the mass-transfer coefficient is 0.05 m/d.
Denitrification doubles for a 10C temperature increase.



Hot Spots for Calibration

	C deposition	N deposition	P deposition	denitrification	solids deposition	respiration
BSHOH		0.008 to 0.032	0.001 to 0.006			
CHSMH		0.02 to 0.064	0.01 to 0.019		3.6	
FSBMH	0.16 to 0.33				0.3	
MPNOH	0.24 to 2.77	0.019 to 0.238	0.004 to 0.085		1.43 to 42.0	
MPNTF						
NANMH	0.033 to 0.126				1.61 to 8.12	
NANOH	0.033 to 0.126				1.61 to 8.12	
PAXOH		0.008	0.002		5.75	
PAXTF		0.033 to 0.064	0.01	0.108 to 0.197	5.75	
PMKOH	0.61	0.05		0.04		1.12 to 2.77
POTTF	1.44			0.043 to 0.06	5.88	
WICMH	0.033 to 0.126	0.037	2.74x10^-5 to 0.004		1.61 to 8.12	
CHOMH		0.053 to 0.074	4.9x10^-4 to 0.005			
WQGIT			0.0016	0.026		

Project Title:

An Investigation of the Composition and Reactivity of Material Eroded from Chesapeake Bay Marshes

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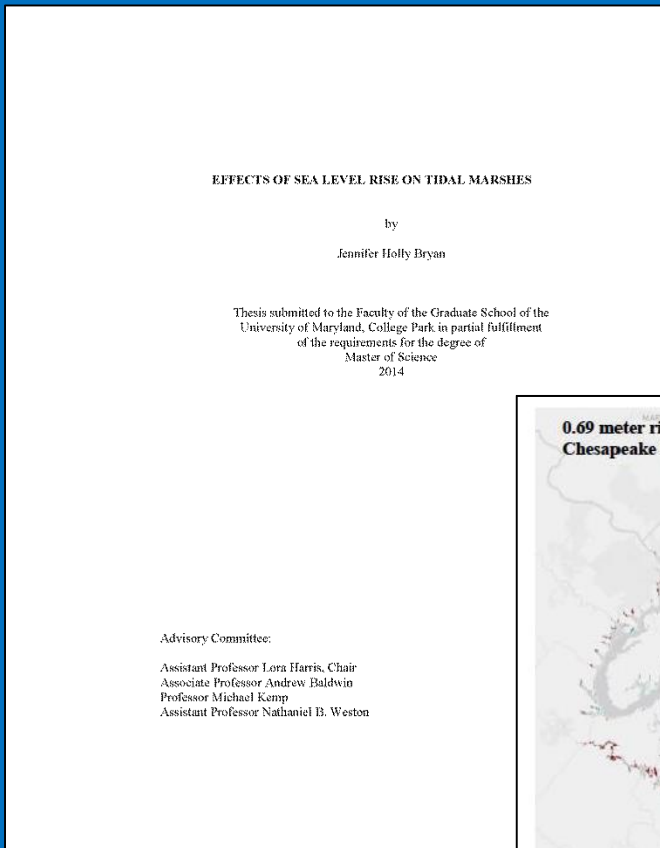
Thus, we propose a program that:

- Characterizes the lability of eroding wetland materials from tidal freshwater, oligohaline and brackish marsh environments;
- Uses direct measures of decomposition for both aerobic and anaerobic estuarine settings;
- Considers the release of inorganic P under different depositional scenarios;
- Ensures reasonable geographic distribution of wetlands, including eastern and western shore environments;
- That is responsive to modeling needs and adapts to modeling needs by constant communication with the sponsor and a mid-point evaluation of the program effectiveness. This latter point of adaptive management is necessary because there is remarkably little comparative data with which to judge this assessment.

Projections - What Do We Need?

1. A base case - current wetland area.
2. An agreed upon climate change scenario – time frame and sea level rise.
3. Projected wetland loss/gain resolved at least to basin scale.

Potential Path Forward



EFFECTS OF SEA LEVEL RISE ON TIDAL MARSHES

by

Jennifer Holly Bryan

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Master of Science
2014

Advisory Committee:

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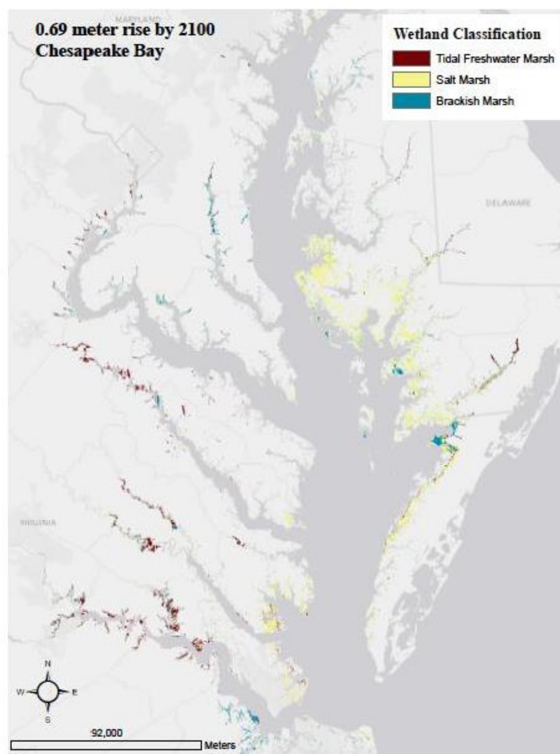

Figure 7 Map showing tidal wetland area in the Chesapeake Bay by 2100 under the 0.69 meter SLR scenario. Map based upon SLAMM 5.0 SLR projections.

SLAMM model application conducted by Patty Glick and expanded upon by Jennifier Bryan and Lora Harris.