MEM + ADCIRC : Application to Coastal Wetlands Impacted by Hurricane Sandy

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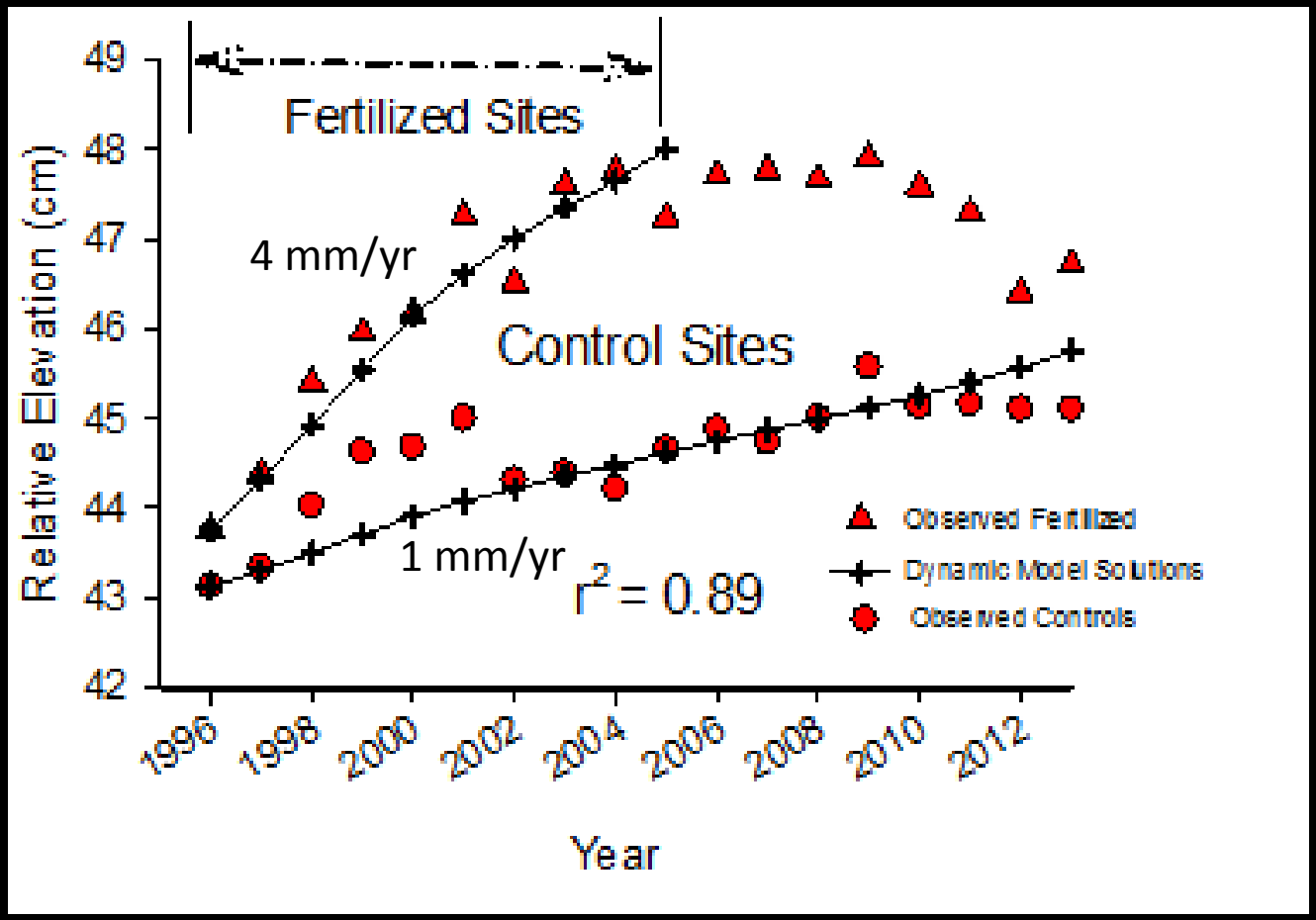


Figure 2. Time series of mean marsh surface elevations (NAVD 88) in plots that were fertilized with N and P and in control plots. Note that the fertilizer treatment was terminated in 2004. The solid lines with crosses are the best fit of the model to the data. Best-fit values of the parameters k_s and q were 0.0735 g^{-1} yr^{-1} and 1.76 x 10^{-3} yr^{-1}, respectively.

Predictions of Marsh Equilibrium Theory: MEM I – a late Picasso

Picasso's Jeune Fille Endormie

$$dY_2/dt = D(q+kB) \quad \text{for } D>0 \qquad (1)$$

Biomass is a function of D: $B=aD+bD^2+c$ (2)

where a, b and c are constants.

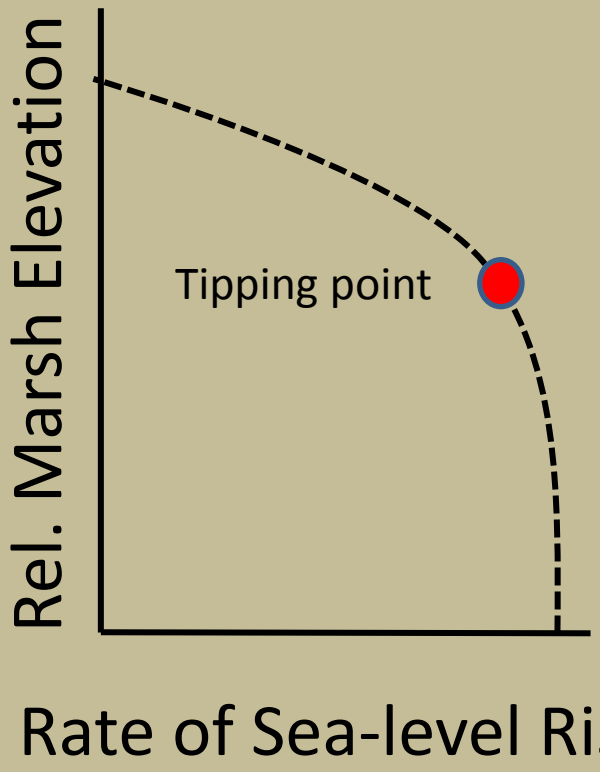
In equilibrium with a rate r of SLR, the marsh surface will maintain an equilibrium depth D, satisfying the following equation:

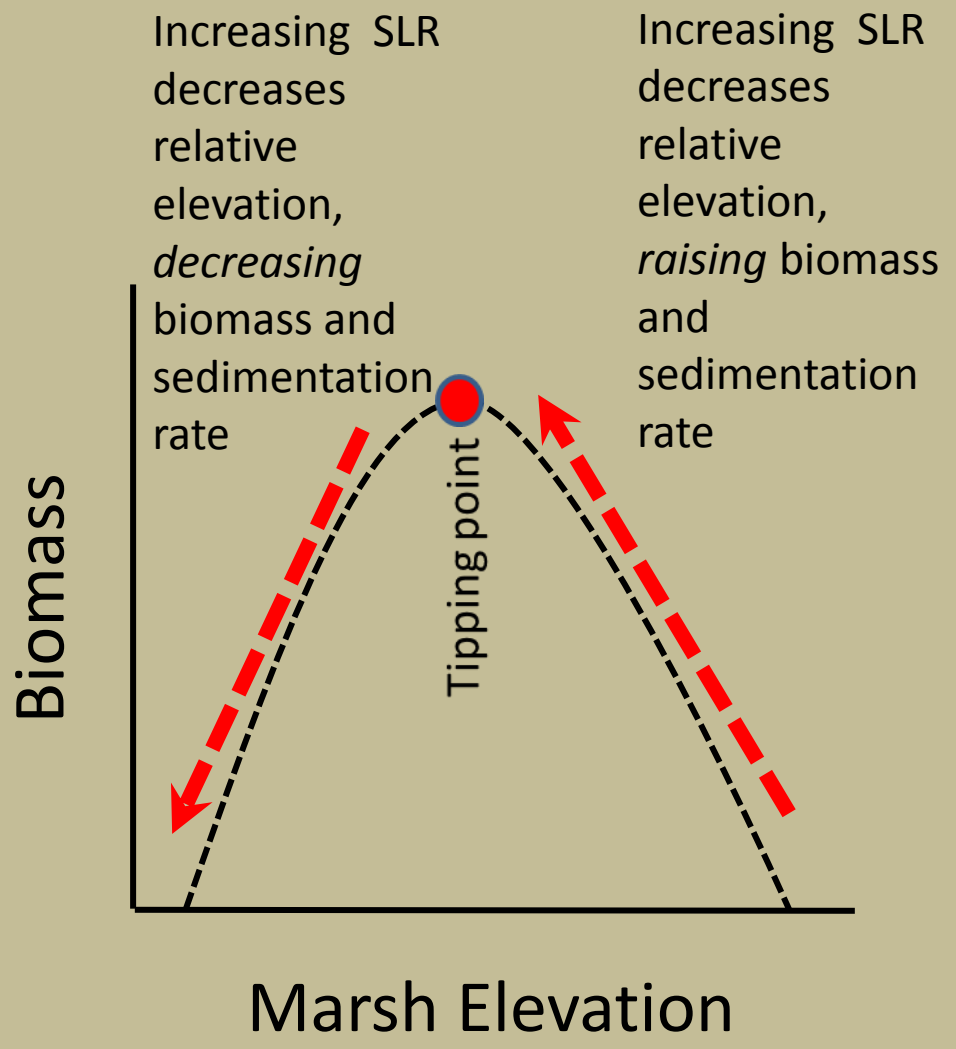
$$kbD^3 + kaD^2 + (q+kc)D = r \qquad (3)$$

Equation 3 has two real roots over a limited range of r (rate of change of sea level), depending on values of a, b, c, q and k.

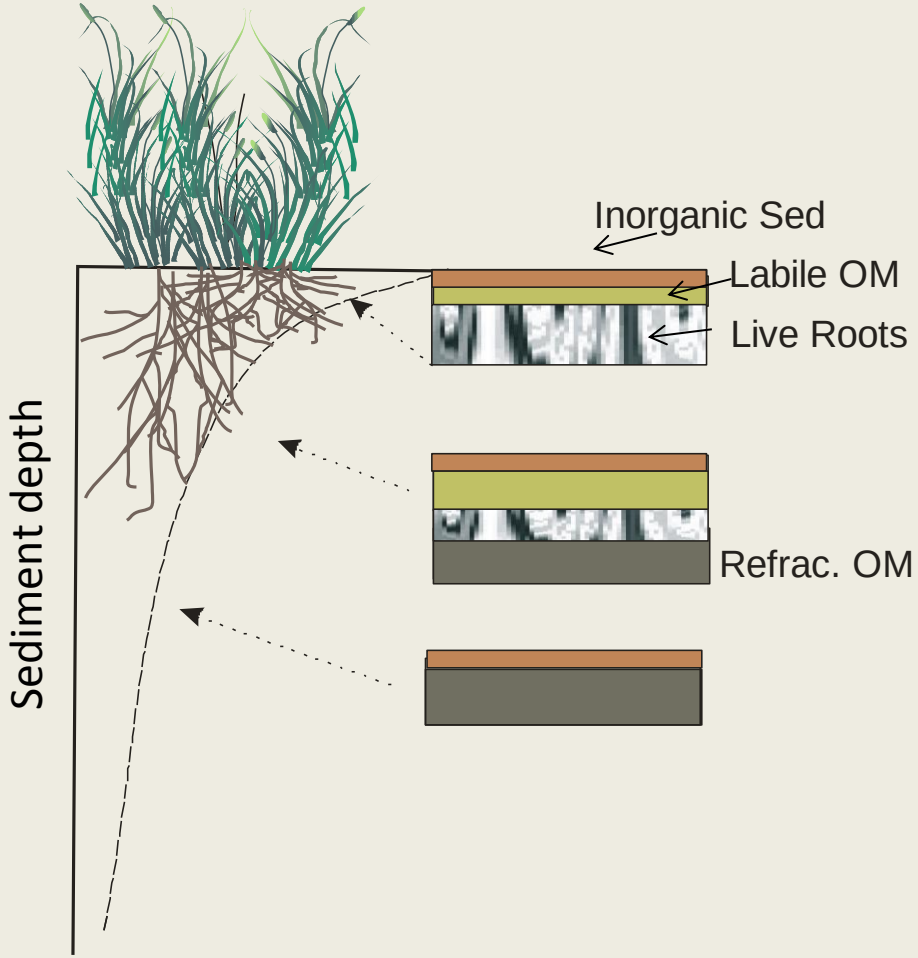
See: Morris, J.T., P.V. Sundareshwar, C.T. Nietch, B. Kjerfve, D.R. Cahoon. 2002. Responses of coastal wetlands to rising sea level. Ecology 83:2869-2877.

Marsh Tipping Point





Soil volume is only created by the addition of organic carbon that resists decay (refractory carbon) and inorganics**. Labile organic carbon does NOT add new volume.**



Morris, J.T. and W.B. Bowden. 1986. A mechanistic, numerical model of sedimentation, mineralization, and decomposition for marsh sediments. Soil. Sci. Soc. Amer. J. 50:96-105.

☐ Use a generic biom profile

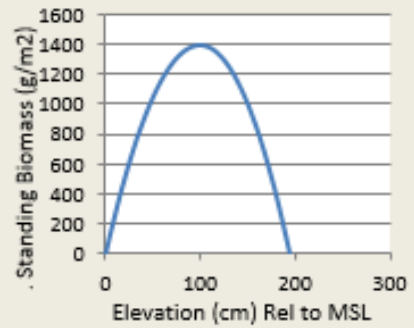
☐ Site is supertidal peat

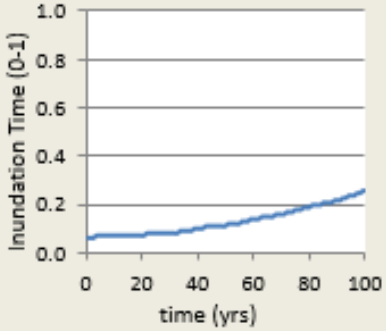
Run Simulation

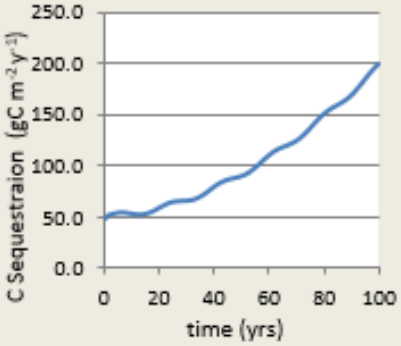
Physical Inputs		
Sea Level Forecast	100	(cm/100y)
Sea Level Today	1.8	cm NAVD
20th Cent Sea Level Rate	0.2	cm/yr
Mean Tidal Amplitude	160	cm
Marsh Elevation @ t0	142.7	cm NAVD
Suspended Min. Sed. Conc.	10	mg/l
Suspended Org. Sed. Conc.	2	mg/l
Biological Inputs		
max growth limit (rel MSL)	195	cm
min growth limit (rel MSL)	0	cm
opt growth elev (rel MSL)	100	cm
max peak biomass	1400	g/m2
%OM below root zone	18.0	
OM decay rate	-0.2	1/year
BGBio to Shoot Ratio	3	g/g
BG turnover rate	0.5	1/year
Max (95%) Root Depth	20	cm
Model-Derived Inputs		
Trapping Efficiency	7.94E-01	$tide^{-1}$
Refrac. Fraction (kr)	5.19E-03	g/g

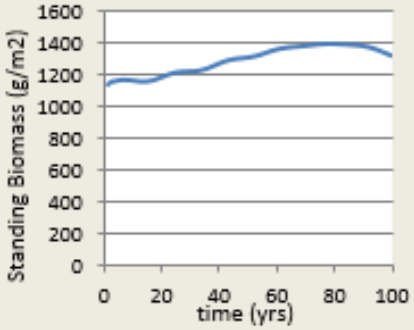
PIE Spartina composite

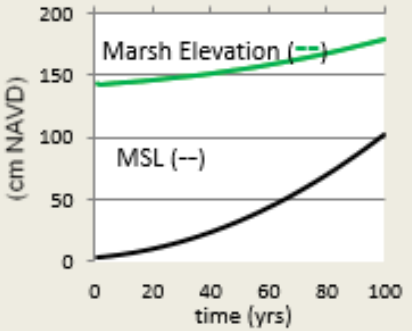
MEM 5

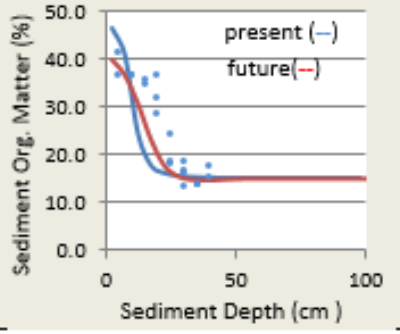




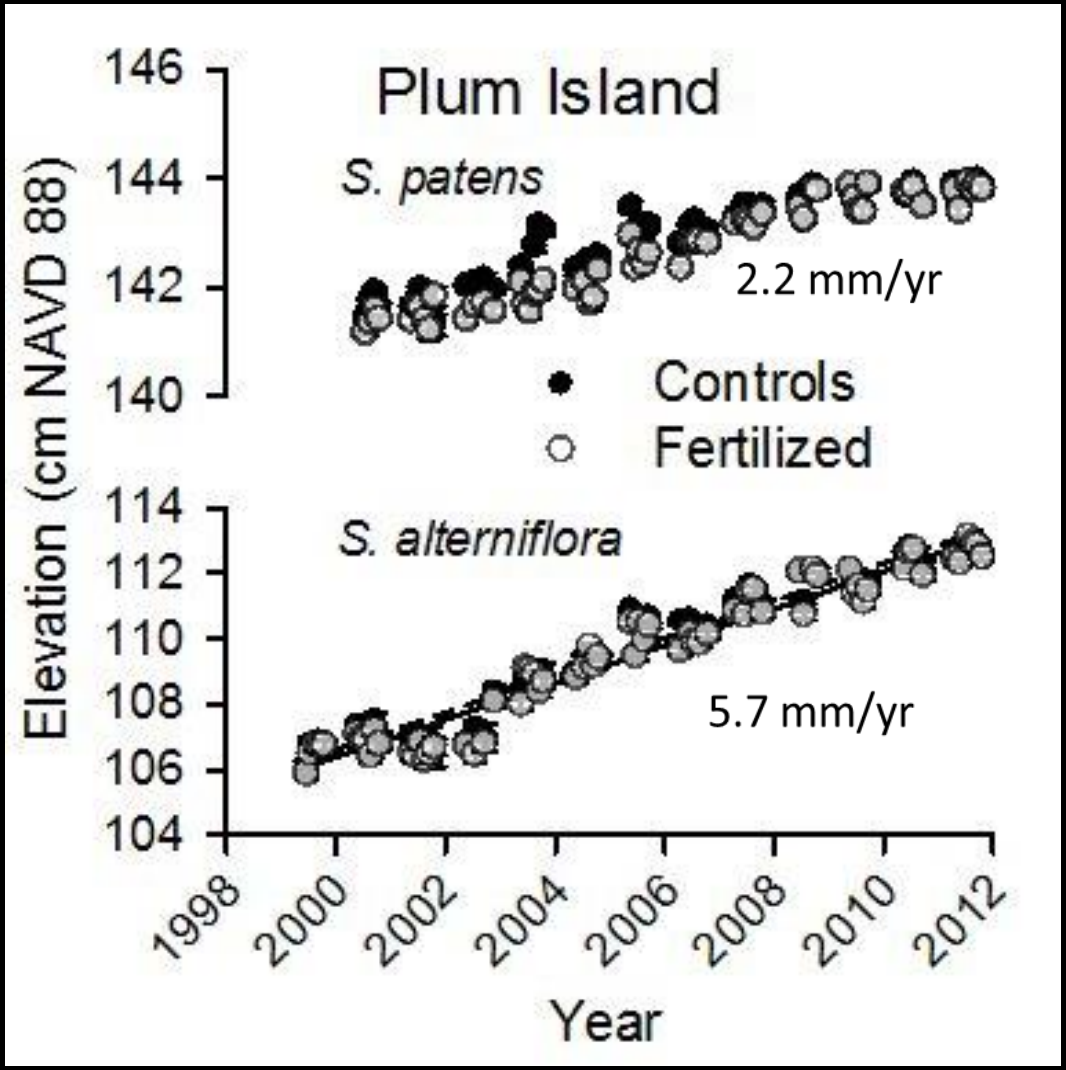








- (•) Plum Island, MA
- ( ) North Inlet, SC
- ( ) Apalachicola, FL
- ( ) Grand Bay, MS
- ( ) China Camp, SFB


Plum Island
S. patens
2.2 mm/yr
Controls
Fertilized
S. alterniflora
5.7 mm/yr
Elevation (cm NAVD 88)
146
144
142
140
114
112
110
108
106
104
1998
2000
2002
2004
2006
2008
2010
2012
Year

Can marsh cannibalization supply the sediment?

LiDAR data show a 0.9% loss of marsh area between 2005 and 2011 (0.27 km^2). That loss of marsh edge if redeposited could add 2 mm/yr of accretion. Thus, **marsh cannibalization** may account for a very significant fraction of total accretion.