Assessing and enhancing salt marsh resiliency under climate change for fluvial vs. marine fed systems

Scott C. Hagen, Henok Demissie, Matthew Bilskie
Louisiana State University

Karim Alizad
University of Central Florida

James T. Morris
University of South Carolina
Question to be answered

- What is Hydro-MEM (Hydrodynamic-Marsh Equilibrium Model)?
- Where is Hydro-MEM being applied?
- Will you show us an example application?
- How are the results being used?
Impact of SLR on salt marshes

Impact of SLR on salt marshes

Impact of SLR on salt marshes

Impact of SLR on salt marshes

Hydro-MEM (Hydrodynamic-Marsh Equilibrium Model)


Assessing and enhancing salt marsh resiliency under climate change
Assessing and enhancing salt marsh resiliency under climate change
Assessing and enhancing salt marsh resiliency under climate change
Assessing and enhancing salt marsh resiliency under climate change
Tidal Model Validation

Assessing and enhancing salt marsh resiliency under climate change
A qualified result from Hydro-MEM at PIE

Biomass distribution

LULC

Assessing and enhancing salt marsh resiliency under climate change
Assessing and enhancing salt marsh resiliency under climate change
Hydro-MEM at Apalachicola: Biomass density validation

*IfSAR Biomass Density

Hydro-MEM Biomass Density

Hydro-MEM at Apalachicola:

Year 2020 SLR scenario
Biomass density

Present day

Assessing and enhancing salt marsh resiliency under climate change
Assessing and enhancing salt marsh resiliency under climate change

Hydro-MEM at Apalachicola:

Year 2050 SLR scenario
Biomass density

Present day

Low                      Int.                      High
Low                      Int. Low                  High
Low                      Int. High                High
Hydro-MEM at Apalachicola:

Year 2100 SLR scenario
Biomass density

Present day

Low                      Int. Low                      Int. High                      High
Tide/surge modeling in the northern Gulf of Mexico

Large-scale region approach

5.5 million compute nodes / ~20,000 km² of floodplain (4.9 million acres)

Five relevant publications

1. Dynamics of sea level rise and coastal flooding on a changing landscape, http://dx.doi.org/10.1002/2013GL058759
3. A coupled, two-dimensional hydrodynamic-marsh model with biological feedback, http://dx.doi.org/10.1016/j.ecolmodel.2016.01.013
4. Tidal Hydrodynamics under Future Sea Level Rise and Coastal Morphology in the Northern Gulf of Mexico, http://dx.doi.org/10.1002/2015EF000332
5. Dynamic simulation and numerical analysis of hurricane storm surge under SLR with geomorphologic changes along the northern Gulf, http://dx.doi.org/10.1002/2015EF000347

Assessing and enhancing salt marsh resiliency under climate change
Assessing and enhancing salt marsh resiliency under climate change
Let’s throw a few hurricanes at it and identify the maximum of maximums elevation for a SLR of 2.0 m.
A floodplain representation from ...

Maximum of maximums (MOM) under SLR of 2.0 m (c. 2100)
Concluding remarks

• We no longer have the luxury of stationarity.

• We can now step out of the bathtub and model the dynamic system.

• Hydro-MEM describes the spatial and temporal variation in tides, accretion, biomass, and provides a scientifically-defensible platform upon which we can build more complexities.

• Climate change is a generational problem that we can address, but not will away.

• While our numerical modeling technology is awesome, with respect to climate change, the models can only serve as advanced diagnostic tools.
Acknowledgments

• National Oceanic & Atmospheric Administration / NOS (Award: NA10NOS4780146)
• LSU/LONI High Performance Computing
• Louisiana Sea Grant

Note: The views expressed herein are the presenter’s and do not necessarily reflect the opinions of his co-authors or:
How to assess event-based climate change/sea level rise impacts to Apalachicola Bay

Assessing and enhancing salt marsh resiliency under climate change