MODELING POTENTIAL BENEFITS FROM MARSH TERRACE RESTORATION: WAVE ATTENUATION, SEDIMENT PROCESSES, AND POTENTIAL SAV HABITAT

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PROJECT GOALS

• Develop a design support tool for design of marsh terrace restoration projects in coastal Louisiana

• Build model to inform potential benefits of projects to:
  1. Wave attenuation
  2. Sediment processes (deposition)
  3. Potential habitat for SAV
POTENTIAL BENEFITS OF TERRACES

-MANY BENEFITS NOT WELL QUANTIFIED-

• Brasher, 2016
• Cost efficient
• Reduce shoreline erosion
• Reduce fetch
• Can be sediment neutral
• Improve nekton habitat
• Improve habitat for ducks
• Foster habitat for SAV
• Create emergent marsh
• Increase sediment deposition
• Construction in 2005, mostly destroyed by Katrina, rebuilt in 2012
• High sediment availability, fresh marsh, terraces build with river dredge material
BUILT 2005 (PRIOR TO KATRINA) WITH DREDGE MATERIAL FROM RIVER

Spring 2018 (March) – low vegetation

Summer 2018 (July) – high vegetation
BUILT 2012 WITH DREDGE MATERIAL FROM RIVER

Spring 2018 (March) – low vegetation

Summer 2018 (July) – high vegetation
• Design plan for marsh terrace project in Bayou Monnaie, Terrabonne Bay, Louisiana (after Ducks Unlimited, 2018)
• Construction commenced February 2018 – 3 months total for construction
• Low sediment availability, brackish marsh, terraces from adjacent sediment
TWO PHASES, CONSTRUCTED 2017 AND 2018

Project constructed 2017

Spring 2018

Summer 2018

Project constructed 2018

Summer 2018
CONTINUOUS MEASUREMENTS

- Deployment: 3/16/2018 – 4/12/2018 (Bayou Monnaie)
  7/31/2018 - present (Bay Alexis)

- RBR
  - Wave & water level

- YSI sonde
  - Salinity, temperature

- ADV
  - Water current
BAY ALEXIS EQUIPMENT

Legend

Equipment Locations
BAYOU MONNAIE EQUIPMENT LOCATIONS
MODEL GRID DELFT3D + SWAN

- Individual terrace dimension: 70 m x 15 m
- Model domain size: 1,840 m x 1,080 m
- Varying model grid size: 5 - 40 m
Larger domain model being refined (different project)

Will provide boundary conditions:
1. wave,
2. water elevation,
3. wind

Allowing the planning tool model to be applied across this larger area
• 5 sediment types (sand, silt, clay, organic marsh soil, consolidated clay)
• Terrace is 3 x 5m grid cells
• top is flat, sides are 45 degree slope
MODEL TEST SCENARIO RUNS

- Comparison between no vegetation and with vegetation (spring – low vegetation) on terraces
- Tide + Wave as open boundary condition
  - Semidiurnal and diurnal tide components from near NOAA station
  - 0.5 m significant wave height with 2 seconds wave period
  - Sand/Silt/Clay = 1 mg/l, 10mg/l, and 10 mg/l, respectively
- Consider spring season for vegetation characteristics
  - vegetation height = 20 cm
  - stem diameter = 1 cm
  - vegetation density = 2,500 unit / m²
  - vegetation area fraction = 20% / m²
- No wind (or associated fetch generated wave, at present)
MODEL OUTPUTS
THREE MONTHS

ST2
Water elevation (cm)

ST4
Water elevation (cm)

ST2
Velocity (cm/sec)

ST4
Velocity (cm/sec)

ST2
Sign. wave height (cm)

ST4
Sign. wave height (cm)
Large wave reduction before terrace (but currently no wind generated wind waves)
Additional wave attenuation within most exposed row of terraces
• Model does not currently have SAV, will be added to some scenarios
• *Heteranthera dubia* (native) was dominant
CUMULATIVE EROSION OR SEDIMENTATION
THREE MONTH TIME PERIOD

cumulative erosion/sedimentation (cm): No Vegetation 01/01/2018 00:00

No
Vegetation

cumulative erosion/sedimentation (cm): With Vegetation 01/01/2018 00:00

Spring (low)
Vegetation
CUMULATIVE EROSION/SEDIMENTATION

No vegetation

With vegetation

With veg. – No veg.
CONCLUSIONS

• Model is developed and functional – can progress to full design tool development

• Identified potential effects of vegetation on terraces for both wave height and erosion - model is sensitive to the scenarios that will be run

• Need to consider that SAV may have a large influence on wave attenuation
NEXT STEPS

- Finalize model and calibrate with field data on wave height, sediment types, vegetation

- Add statistical model for calculating potential SAV habitat (salinity, water depth, disturbance, turbidity)
  - Test various terrace designs
  - Test vegetation types and canopy structures
  - Test various wind and wave conditions and directions

- Finalize terrace design support tool