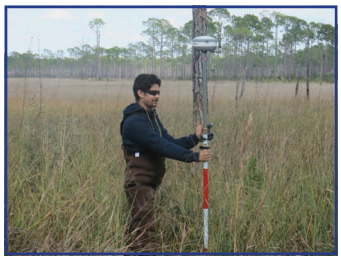
Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico




The Ecological Effects of Sea Level Rise – Northern Gulf of Mexico (EESLR-NGOM) is an integrated field observation and modeling project that will provide resource managers with the knowledge and tools to prepare for the impacts of tides and storm surge from sea level rise with increased certainty in scale, timing, and local detail. Improving forecasts of dynamic ecosystem responses to sea level rise and storms will enable coastal zone managers to more effectively assess alternative management strategies for mitigating future ecological and societal impacts.

Issue

The northern Gulf of Mexico benefits from a wealth of natural resources and an economy dependent on healthy coasts. However, the combined impacts of rising sea level and tropical storms on the northern Gulf's coastal areas will be dramatic and present a significant threat to coastal communities and ecosystems.

Approach

This multidisciplinary project led by the University of Central Florida builds on laboratory experiments and field observations and experiments at three National Estuarine Research Reserves (NERRs, map shown above) to inform a suite of predictive models. The team is combining models of water circulation, overland flow, and coastal hydrodynamics with models of sediment transport from the watershed to the sea. These models will incorporate shoreline erosion and predict sediment loading to coastal marshes and waters, as well as estuarine and bay salinity transport. The physics/biological-based models and assessments will allow for forecasts of intertidal marsh evolution and inform marsh, seagrass, and oyster habitat models.

Management Applications

It is worth noting that this project has already formed the basis for the Northern Gulf of Mexico Sentinel Site. One critical component of this project is to ensure that results are applicable to management practice. This is facilitated by an applications management committee that has been involved in tool development from the project start. Management application products will include the development of:

- Priorities for reducing risk
- Setback, shoreline restoration, and breakwater construction guidance
- Resource sustainability guidance for project planning
- Dynamic simulations of hurricane storm surge under various sea level rise scenarios

Project at a Glance

Title: Ecological Effects of Sea Level Rise – Northern Gulf of Mexico

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Geographic Scope
Mississippi to Florida's Big Bend, with focus on three National Estuarine Research Reserves: Apalachicola (ANERR), Grand Bay (GBNERR), and Weeks Bay (WBNERR)

Products
- Coupled models of hydrodynamics, salinity, sedimentation, vegetation, and oyster dynamics
- Classified maps indicating high and low risk areas

Targeted Users
- State and local planners and resource managers
- Staff and researchers at NERRs
- Federally protected area managers

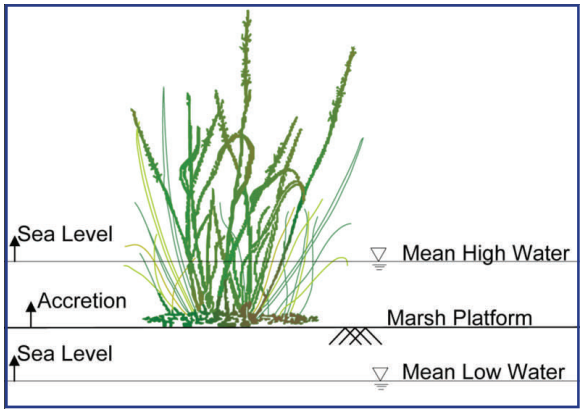
Academic Partners
- Florida State University
- University of Central Florida
- University of South Carolina

Other Partners
- National Oceanic and Atmospheric Administration (NOAA)
- ANERR, GBNERR, and WBNERR
- Dewberry, Inc.
- Gulf of Mexico Alliance
- Mobile Bay National Estuary Program
- Sea Grant
- U.S. Fish and Wildlife Service

Related Efforts
- NOAA Sentinel Site Program
- Climate Community of Practice
- Landscape Conservation Cooperatives
- NERR Sentinel sites

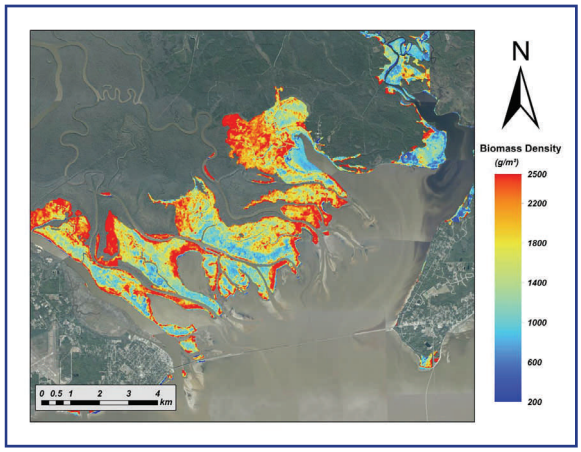
How does the marsh maintain equilibrium with sea level rise?

The graphic to the right depicts *Spartina alterniflora*, a common saltmarsh grass found throughout the Northern Gulf of Mexico and the U.S. east coast, and its relation to local water levels. The grass thrives when the marsh platform that it grows on is located at an elevation between mean high water (MHW) and mean low water (MLW). As sea level rises, so do MHW and MLW. In order for saltmarsh grasses to remain productive the rate of accretion (the buildup of organics and inorganic sediments) must keep up with the rate of sea level rise.



The "marsh organ" to the left is a field experiment device that contains rows of PVC pipes to simulate various levels of marsh platform elevation. By planting saltmarsh grasses that are particular to the local marsh, we can correlate the grasses' response to various sea levels. As a result of the field experiments, a marsh equilibrium model can be developed.

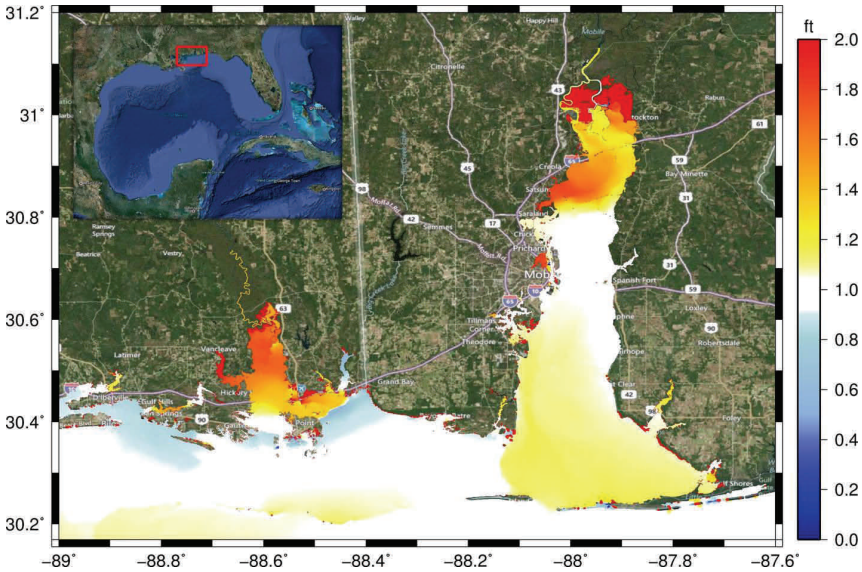
The map to the right shows marsh plant density at Apalachicola NERR. The base marsh equilibrium model from the field experiment and the overall process is enhanced by field data collection. This includes total suspended solids, sediment cores, overland soil classifications, sampling of marsh grasses throughout the region, and sediment elevation tables. The marsh model is then coupled to a tidal hydrodynamic model that results in a capability to project marsh response for multiple scenarios of sea level rise.



How do sediment and sea level affect oysters?

Different species respond to sea level in different ways. We are conducting field and laboratory experiments to test how intertidal oysters respond to changes in water level and sedimentation.

This photo shows an "oyster ladder," which tests the effects of water level and sediment on oyster growth and survival. We are also conducting laboratory experiments that examine oyster sensitivity to sediment grain size and concentration.



Dynamic Hurricane Storm Surge Modeling

Storm surge results in flooding and has powerful effects on the coastal zone. The figure to the left shows the increase in storm surge that would be caused by Hurricane Katrina if it occurred under a sea level rise scenario. The model incorporates:

- Waves, tides, and surge
- Land use changes
- Habitat changes
- Shoreline evolution

The results of this project will let us combine storm surge predictions under various sea level rise conditions with the ecology models and predict how hurricanes might impact coastal regions in the future. This will help managers protect our natural and human-built coastal resources.