# Implications of black mangrove colony expansion in Gulf of Mexico coastal wetlands on sea level-induced land loss and estuarine productivity

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Coastal saline wetlands (CSW) are sensitive to sea level rise rates that exceed organic+mineral accumulation rates. The Gulf of Mexico (GOM) may also be particularly sensitive to flora characteristic of tropical latitudes expanding northward as climate warms. With predicted climate moderation, we posit that mangrove (*Avecennia germanans)* colonies, that today are limited in the GOM by severe freezes that control colonization area and individual tree size, may expand at the expense of *Spartina spp.* marshes. The present project, which will begin in April 2009, has as specific objectives the following hypotheses:
***1.*** Higher organic production rates (leaf-litter and roots) and reduced decomposition (Hyp. 2) lead to higher organic accumulation rates in *A. germinans* colonies relative to adjacent *Spartina ssp.* marsh soils. The year-round presence of pneumatophore mats also makes them more efficient (averaged annually) at trapping mineral sediment than *Spartina ssp.* stems.
***2.*** CSW soils in *A. germinans* colonies have lower pH, higher sulfide content, and more limited oxygen penetration than adjacent *Spartina ssp.* This retards remineralization of mangrove organic matter and results in higher rates of organic accumulation than in adjacent *Spartina ssp.* areas. This impacts soil surface elevation and organic carbon sequestration rates. *A. germinans* OM flux to estuaries, due to higher organic production rates and selective colonization of wetland edges (e.g., tidal creeks), is greater per unit area (and of different composition) than *Spartina ssp.* OM flux**.**
***3.*** Soil surface elevation in *A. germinans* colonies is higher than in adjacent *Spartina ssp.* marshes. This is a function of higher sediment accumulation rates (H1), rapid root volume expansion of the growing tree, and of selective colonization by mangroves of creek banks (where tidal flushing and nutrient supply is greater) that have fringing natural levees pre-establishment. This elevation differential makes mangrove-colonized areas less susceptible to land-loss associated with relative sea level rise.
***4.*** Mangrove-colonized CSW areas are more resistant than *Spartina ssp.*-dominated areas to the storm wave-induced land loss of open-water facing shorelines. This is a function of the higher elevations (soil surface and canopy) to damp waves and increased root volume and depth maintaining soil coherence. Due to increases in both organic and mineral accumulation (Hyp. 1) relative to *Spartina ssp.* marshes, we do not anticipate a significant difference in soil strength.

Three mixed *A. germinans-Spartina spp.* wetland areas spanning a range of latitudes will be examined in the western GOM, 1) Lower Texas (South Bay-Laguna Madre, Cameron Co.), latitude 26.1°N, 2) Central Texas (Matagorda Bay, Calhoun Co., 28.5°N, 3) Mississippi Delta (Terrebonne Bay, LA), 29.2°N. Exact site selection will be determined with remote sensing imagery. Sites will be mapped for cm-accuracy elevation. Peat auger (no compaction) samples will be collected from both wetland types and sampled for geotechnical (water content, penetrometer, vane shear, loss on ignition) and geochemical (pH, Eh, sulfide, salinity, etc.) properties. Sediment cores will also be taken from the wetland surface and adjacent water bodies to analyze for organic matter preservation (TOC, TON, etc.), sediment accumulation ($^{210}$Pb, $^{137}$Cs), stable isotopes ($\delta^{13}$C and $\delta^{15}$N), and pigments and lignin-phenols as tracers of plant carbon (woody vs. grass) source. We anticipate the study will yield peer-reviewed publications designed to examine the global implications of coastal saline wetlands with respect to impact of predicted rises in sea level, their resistance to cyclonic storms, and the implications for global carbon storage. Deliverables will also include a large body of observational data, which can be utilized to calibrate models of wetland loss with sea level rise and of wetland-estuarine ecology.