Georgia Coastal Ecosystems (GCE)

The Georgia Coastal Ecosystems (GCE) LTER program began in 2000. It continues a strong history, dating back to the 1950's, of scientific study of Georgia's estuaries by scientists at the University of Georgia and the Sapelo Island National Estuarine Research Reserve. Field work for the program is based at the University of Georgia Marine Institute on Sapelo Island. Over 60 participants are currently involved in GCE research and educational programs, representing 14 academic institutions and agencies.

The focus of the GCE LTER is on salt marshes and estuaries, which are the most common coastal habitats along the Atlantic and Gulf coasts of the United States. These areas are among the world's most productive and provide many ecosystem services, such as providing protection from storms and erosion, filtering nutrients and pollutants from the water, supporting commercial and recreational fisheries, and providing opportunities for a range of recreational activities. Over the coming decades, the Georgia coast is expected to experience substantial changes due to factors such as climate change, sea level rise, and human alterations of the landscape. The overarching goal of the GCE LTER is to understand the mechanisms by which variation in the quality, source and amount of both fresh and salt water create temporal and spatial variability in estuarine habitats and processes, in order to predict directional changes that will occur in response to long-term shifts in estuarine salinity patterns.

Site Description and Characteristics The GCE domain encompasses three adjacent sounds (Altamaha, Doboy, Sapelo) and includes upland (mainland, barrier islands, marsh hammocks), intertidal (fresh, brackish and salt marsh) and submerged (river, estuary, continental shelf) habitats. The Altamaha River is the largest source of freshwater to the domain and provides a natural gradient of freshwater inflow to the sites. It drains a watershed of 36,700 km^2 and is relatively undeveloped (58% forest; 19% agriculture, and 10% urban/suburban). On the ocean side, the domain is bounded by the South Atlantic Bight, which extends from Cape Hatteras, NC to West Palm Beach, FL. The broad expanse of the Continental Shelf in this area helps to protect the coast from wave and storm activity but it also serves to funnel the tides, which are semi-diurnal and range in height from 1.8 m (neap) to 2.4 m (spring). Vegetation in the GCE is representative of the southeastern coast, and includes salt marshes (dominated by salt marsh cord grass, *Spartina alterniflora*, and black needle rush, *Juncus romerianus*) and maritime forest (dominated by live oak, *Quercus virginiana*) that grade into brackish and fresh marshes and floodplain bald cypress forest. Annual average precipitation is 127 cm and temperature is 20°C.

GCE study sites that are distributed along an onshore-offshore gradient across the domain and span the full range from tidal fresh to tidal marine habitats. The program monitors key ecosystem variables, including measurements of the atmosphere, groundwater, riverine inputs, the water column within the estuaries, and intertidal areas (marsh sediments, vegetation, and invertebrates).

Research Focus Patterns and processes in this complex landscape vary on multiple scales, both spatially (within and between sites) and temporally (tidal, diurnal, seasonal, and interannual). Overlain on this spatial and temporal variation are long-term trends caused by increasing human population density, which influences land and water use patterns; climate change, which affects sea level rise and precipitation patterns; and other alterations, such as dredging or changes in fishing strategies.

The objectives of the GCE are 1) to continue to document long-term patterns of environmental forcing to the coastal zone, 2) to link environmental forcing to observed spatial and temporal patterns of biogeochemical processes, primary production, community dynamics, decomposition and disturbance, 3) to investigate the underlying mechanisms by which environmental gradients along the longitudinal (freshwater-saltwater) and 4) lateral (upland-subtidal) axes of estuaries drive ecosystem change, and 5) to explore the relative importance of larval transport and the conditions of the adult environment in determining community and genetic structure across both the longitudinal and vertical gradients of the estuary. To meet these objectives, we utilize a suite of approaches including long-term monitoring of abiotic drivers and ecosystem responses; manipulative and natural experiments designed to enable us to examine the importance of key ecosystem drivers; and modeling.