Hydrogeophysical transect across a barrier island in the Georgia Bight using time-domain electromagnetics

Ahmed Elshennawey, Mark Everett, Charles Pell, Georgianne Moore

To support our ongoing ecosystems research on Sapelo barrier island in the Georgia Bight of the US Atlantic coast, we have acquired a series of time-domain electromagnetic (TDEM) soundings. The TDEM transect spans the entire E-W width of the island from the back bay lagoon, across a human-modified tidal creek and associated wetlands, and a pine forest, to the beach dune system at the seacoast. The soundings are made with a 10 m square loop with central receiver using Geonics G-TEM equipment. We find that the soundings made at the lagoon and coastal sites are dominated by saltwater and show no sign change in the recorded voltage response, indicative of 1-D structure. Interior to the island, where the influence of the tidal creek and surrounding salt marsh is prevalent, the soundings do exhibit a sign change that is indicative of lateral heterogeneity. We use finite element analysis to build an island-crossing 2-D model across the strike of the N-S tidal creek that explains the soundings along the entire transect. The resulting 2-D model is interpreted hydrologically to provide regional context to our ongoing ecosystems research into groundwater-surface water interactions between the tidal creek and salt marsh along with the transition zone from the salt marsh to coastal marine forest. The geoelectrical structure we find also informs models of local sea level rise and has implications for coastal hazard resilience of the traditional community that lives on the island.