Project title: Salt-water intrusion into coastal freshwater wetlands: Effects on ecosystem metabolism and soil carbon and nutrient storage

Personnel: Scott C. Neubauer, Univ. of South Carolina, Baruch Marine Field Laboratory

Objectives: Wetlands at the freshwater end of the coastal zone are often species-rich, have high rates of primary production, and contain large reservoirs of soil carbon and nutrients. Sea level rise is expected to cause the movement of salt water into these ecosystems. The overall objective of this project is to understand the effects of salt-water intrusion into tidal freshwater wetlands, with emphases on quantifying ecosystem metabolism over diurnal, tidal, seasonal, and annual time scales and determining changes in soil carbon and nutrient pools.

Science questions: Since June 2008, brackish water has been added to plots in a South Carolina tidal freshwater marsh to simulate salt-water intrusion. Through mid 2009, gross ecosystem production and dark CO_2 emissions in control plots were 1.7 to 1.8 times greater than rates in salt-water plots, whereas CH_4 emissions showed only transient responses to salt-water additions. The net result of the decreases in production and respiration was a nearly 50% drop in net ecosystem exchange in salt-water plots. This project will expand the existing research plan by addressing the following: *1)* What are the effects of salt-water intrusion on ecosystem primary production, decomposition, biodiversity, and soil carbon/nutrient storage? *2)* How does flooding affect rates and pathways of marsh-atmosphere-water exchanges? *3)* Do the effects of salt-water intrusion on system metabolism change as the duration of salt exposure increases? NICCR funding would support the third year of manipulation at the site. –and– *4)* How does persistent, multi-year exposure to salt-water affect pools of soil carbon, nitrogen, and phosphorus?

Research location: Tidal freshwater marsh on the Waccamaw River (South Carolina) where PI Neubauer has been conducting a salt-water intrusion project since 2008.

Methods: The project outlined below will continue and enhance the on-going salt-water intrusion study on the Waccamaw River. The existing salt-water manipulations have raised porewater salinities to ~2-6 and are relevant for understanding climate change in the Atlantic coastal region over the next 50-100 years. Sampling will include: *I)* Regular measurement of exchanges of gaseous and dissolved CO_2 and CH_4 between the marsh, atmosphere, and tidal floodwaters. During these measurements, natural tidal rhythms will be maintained within experimental flux chambers. *II)* Gas flux data will be integrated with environmental (air/soil temperatures, light) and tidal (frequency, depth of flooding) data to calculate marsh metabolism (gross ecosystem production, respiration, net ecosystem exchange). –and– *III)* Soil cores will be collected from all experimental plots and analyzed for total and extractable levels of carbon, nitrogen, and phosphorus so elemental inventories and accumulation rates (with ^{137}Cs dating) can be calculated.

Results and deliverables: This work has implications for the biogeochemical functions and services provided by tidal freshwater wetlands, including carbon sequestration, marsh-atmosphere greenhouse gas fluxes, and water quality improvement functions. Results will be disseminated via publications and presentations at regional, national, and international venues. Through this project, a technician and undergraduate interns will be trained in ecosystem science and global change biology. Significantly, this project will extend and add considerable value to an existing project on salt-water intrusion effects, the longest-running study of its kind.