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TITLE: Greenhouse gas fluxes from coastal wetlands at the intersection of urban pollution and saltwater intrusion: A soil core experiment

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ABSTRACT:

Wetlands serve an important role in regulating greenhouse gases globally. Anthropogenic stressors including elevated nutrients and contaminants from urban pollution and elevated salinity from saltwater intrusion have the potential to alter greenhouse gas emissions, particularly in tidal wetlands that experience these stressors simultaneously. We designed a laboratory soil core experiment to disentangle the separate and combined effects of saltwater intrusion (elevated salinity versus elevated sulfate) and urban pollution (elevated nitrogen versus elevated copper) on carbon and nitrogen cycling in wetland soils. We collected 45 intact soil cores from a brackish tidal wetland and applied chemical treatments for seven weeks in the laboratory. We measured greenhouse gas soil-to-atmosphere fluxes (CO2, CH4, N2O) and porewater chemistry weekly. Soils were harvested at the end of the experiment to analyze soil chemistry and microbial carbon and nitrogen processing rates. Compared to the freshwater control, we found that elevated copper and sulfate (without elevated salinity) decreased CH4 fluxes. Treatments with elevated salinity, sulfate, or both also reduced CO2 fluxes. Likewise, carbon mineralization at the end of the experiment was lower for all treatments with elevated copper, sulfate, or salinity. In contrast, elevated salinity enhanced N2O fluxes but did not affect potential denitrification rates at the end of the experiment. Combined urban pollution and sea salt enrichment suppressed carbon gas fluxes but enhanced N2O emissions. Decreased carbon gas fluxes offset increased N2O fluxes such that the saltwater, urban, and combined treatments reduced the total global warming potential by 6.9×, 2.6×, and 3.6×, respectively, relative to the freshwater control. Thus our laboratory experiment suggests in the short-term, saltwater intrusion could reduce global warming potential of coastal wetland soils in Southern New England with typical levels of urban pollution. Future research that addresses the response of coastal wetland ecosystems to combined effects of urban pollution and saltwater intrusion will be critical for predicting long-term coastal wetland function under future land use and climatic conditions.

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