Fe-OM associations may act as a mechanism for DOC mobilization in coastal upland forest

Coastal environments are experiencing increased storm surge and saltwater flooding due to climate change, which may influence soil carbon stability and turnover mechanisms. These mechanisms include changes in ionic strength and soil organo-mineral complexes which may release organic matter (OM) associated with soil minerals into solution. Terrestrial Ecosystem Manipulation to Probe the Effects of Storm Treatments (TEMPEST) is a large ecosystem scale experiment located in Chesapeake Bay that is designed to mimic the impact that potential flooding disturbances (storm surges) would have on upland coastal forest. Field observations indicated that there was a change in dissolved organic carbon (DOC) released after flooding the TEMPEST experimental forest with saltwater for a year following experimental inundation. To explore potential mechanisms behind these observations, upland soil collected from the control plot of TEMPEST was washed with saltwater, while oxygen exposure was altered to mimic shifts in oxygen availability that occur during flooding. Subsequent washes with DI water were performed to simulate subsequent precipitation events, and each wash was centrifuged to examine DOC present in colloidal fractions (0.45-1.0 μm, 0.1-0.45 μm, and <0.1 μm) to understand which size fractions the bulk of DOC is mobilized in. Carbon was quantified and characterized using total organic carbon (TOC) and colored dissolved organic matter (CDOM) and the mineral components were analyzed using the ferrozine assay and inductively coupled plasma mass spectrometry (ICP-MS). We found that DOC concentrations peaked several washes after the initial saltwater wash, and that the 0.1-0.45 μm fraction contained the bulk of the mobilized DOC across the different fractions. The observed correlation between Fe(III) and DOC, specifically aromatic DOM, suggests that there may be disassociation of aromatic ligands following transformation of Fe(II) to Fe(III) that may be important for DOC mobilization. Results from these experiments suggest that the inundation of coastal upland forest may trigger changes in Fe-OM associations across different ionic strengths that may impact soil carbon stability in coastal forest soils following salinity exposure. Better understanding of these mechanisms will increase understanding of how changes in storm surge and sea level rise driven by climate change may impact carbon cycling along threatened the coasts.