Title: **Multiscale Observations and Modeling for Improved Prediction of Coastal Wetland Processes**

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Project Abstract: COMPASS-FME has established field sites for intensive synoptic studies in two distinct geographies: in brackish marsh systems of the Chesapeake Bay, and in freshwater wetlands of the Western Lake Erie Basin. Within each region, three sites were selected to establish transects that span elevation gradients consisting of coastal upland forests, forest-wetland transitions, wetlands, and nearshore open waters. The sites also lie along regional gradients in salinity in the case of Chesapeake Bay and gradients in nutrient loading and geomorphology in both regions. Measurements that are being made now and are planned for the coming season include observations of subsurface and surface biogeochemical, plant physiological, hydrological, and geophysical processes. Modelers and observationalists are working together to define multi-scale measurements and simulations to elucidate processes at each site. Modeling is being conducted at point, column, and transect scales using a hierarchy of process-resolving models. Simulations of biogeochemistry at the scale of the soil pore space are capturing microbial dynamics, redox reaction networks, organic matter decomposition, and gas flux. Simulations in single vegetation/sediment/soil columns include those pore-scale dynamics, and introduce variability along vertical gradients in temperature, moisture, oxygen concentration, salinity, and organic matter composition. Two-dimensional transect simulations integrate pore-scale and vertical dynamics along the horizontal transition from wetland to upland conditions, including the effects of inundation from the wetland side and freshwater flooding from the upland side. Here we present results from simulations at each of the three scales (pore, column, transect), based on preliminary observations from COMPASS-FME synoptic sites. These results have helped to refine COMPASS-FME field activities, prioritizing measurements to be gathered in the upcoming field season. For example, we are prioritizing physical characterization of soils, quantifying interactions between iron and sulfur cycles, and extending measurements of plant physiology across all the synoptic sites.