Coastal Observations, Mechanisms, and Predictions Across Systems and Scales – Field, Measurements, and Experiments (COMPASS-FME)

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Project Abstract: Coastal terrestrial-aquatic interfaces (TAIs) occupy relatively small areas of the Earth's surface but play an outsized role in global biogeochemical cycles. Both marine and freshwater coastal TAIs compress and expand with tides, sea- and lake-level variation, global change, and land use, making prediction of C and nutrient dynamics difficult.

The Coastal Observations, Mechanisms, and Predictions Across Systems and Scales – Field, Measurements, and Experiments (COMPASS-FME) pilot study is a multi-institutional effort to understand the interactions of waters, soils, microbes, and plants within coastal TAIs to inform the development, testing, and application of multiscale, hierarchical models. COMPASS is being piloted at select sites in the Chesapeake Bay and Lake Erie regions to understand the causes, mechanisms, and consequences of the shift between aerobic and anaerobic conditions related to the interacting water-soil-microbe-vegetation system. We focus on the fluxes and transformations of carbon, nutrients, and redox-sensitive elements in ecosystems influenced by coastal water exchange; these gaseous, aqueous, and particulate fluxes and transformations must be mechanistically resolved to enable coupling between land, wetland, and open-water systems in regional models and ultimately Earth system models. Studies in these two regions allow us to compare and contrast how ecosystem control points emerge along differing gradients in topography, soil saturation, ionic strength, redox state, and nutrient availability.

Our research is guided by model analyses and benchmarking to identify model uncertainties and sensitivities and data syntheses to prioritize measurement needs. We leverage ongoing, multi-agency studies to gather consistent data from dozens of locations and capture temporal dynamics with synoptic studies in multiple fixed and temporary locations. Experiments will test hypotheses about the interactions among waters, soils, microbes, and vegetation at coastal TAIs. This plan addresses a DOE priority for a systems-level understanding of coastal ecosystems that integrates measurements, models, and experiments to develop a scalable, flexible, and process-rich coastal ecosystem modeling framework.