Poster #9-18

Peatland Hydrology Across Scales: Coupling Carbon Emissions with Water Table Fluctuations

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Our project aims to guide future representations of peatland hydrology and water-carbon feedbacks within Earth System Models, by developing a nested series of parsimonious, stochastic, and process-based hydrological models that can quantify the effects of temporal hydroclimatic variability and spatial heterogeneity on peatland carbon emissions. Due to the influence of water table depth on aerobic versus anaerobic conditions, which control the oxidation and production of CH_4 within the peat column, water table fluctuations can strongly regulate the timing and magnitude of these metabolic processes. Thus, our research questions are centered on the three key drivers of water table fluctuations within peatland watersheds: (1) temporal hydroclimatic fluctuations, (2) spatial heterogeneity of bog microtopography, and (3) hydrological connectivity across the peatland watershed. We intend to validate our models against existing long-term datasets within the Marcell Experimental Forest (MEF), and collect new data whenever necessary.

To date, we have installed automated water table gauges (in summer 2018) at the bog-forest boundary at MEF, which will give us new information about the timing and amount of lateral water subsidies into the bog from its surrounding upland forests. These lateral inputs are expected to magnify the hydrological response within the bog during high intensity rainfall and snowmelt events. Furthermore, we have demonstrated using eddy covariance data at MEF that the annual CH_4 emissions is strongly correlated with later onset of seasonal infiltration (i.e., if snowmelt and heavy precipitation occur later in the year). Currently, we are working to incorporate the seasonal dynamics of specific yield, lateral flow, and precipitation into a water balance model that will be used to predict the daily and seasonal variations in water table depths. This water balance model will be coupled to a new, stochastic reaction kinetics model to predict peatland carbon emissions in response to variable hydroclimatic forcing.