Poster #62

The Role of Phenolic Compounds, Aromatics and Black Carbon Controls on Decomposition, GHG losses in Peatlands Along a Latitudinal Gradient from Minnesota to Peru

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The primary mechanisms responsible for peatland formation in boreal regions are typically attributed to cool and uniformly wet soil conditions that limit microbial respiration. However, outside of boreal regions peatlands are widespread and continue to accrete carbon despite higher temperature, seasonal drying of root-zone soil strata and recurring patterns of wildfire. This implies additional regulatory mechanisms constrain rates on organic matter decomposition and could be the primary controllers of carbon accretion in subtropical and tropical peatlands. We propose a dual control or “latch mechanism” model that predicts decomposition rates in subtropical and tropical peatlands are regulated by: (1) higher production of polyphenol and aromatic compounds in the litter of low-latitude shrub/tree communities than found in northern *Sphagnum/Carex* communities and (2) the selective removal of labile carbon and buildup of recalcitrant pyogenic OM produced by frequent low-intensity wildfires in the native-fire-adapted communities. Wildfire season in southeastern peatlands occur in the late spring when vegetation is desiccated and peat soils have high moisture content. Notably, the surface soil layers are typically subjected to flash-heating with a rapid loss of soil moisture but little loss of soil organic matter (SOM). Key findings to-date include 1) a latitudinal gradient of carbohydrates and aromatic/phenolic compounds with low-latitude peat having fewer carbohydrates and greater aromaticity, which indicate that southern peat is more recalcitrant than boreal peat; 2) chronosequence of low-intensity prescribed burns and laboratory fire simulations showed lower H/C ratio, lower sugar+carbohydrate and lower klason lignin at burned sites; 3) Incubation of burned and unburned peat replicates over more than six months showed an initial pulse of CO_2, CH_4 and NO_2 emissions, but within four weeks emissions from the burned replicates dropped significantly below those unburned replicates. After accounting for small initial losses of organic matter (<10 %) during the fire simulations, thermal alteration of peat resulted in a net long-term reduction in carbon loss; 4) High phenolics in shrub peatlands have overarching control on the diversity and abundance of fungi—the predominant peat decomposer, thus directly decreasing carbon decomposition, but also shifting fungal composition from fast-growing to slow-growing species. This further decreases climatic decomposition sensitivity and stabilizes stored carbon. In this growing season, based on our current results we will further conduct indepth microbial, biological and chemical analysis to explore the underlying adaptive control mechanisms in temperate and tropical peatlands, thus further improving our phenol/black carbon model.