Poster# 104

Impact of Warming on Microbiology and Carbon Cycling in Deep Soils.

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Subsoil horizons contain more than half of global soil organic C stocks. While bulk C turnover at depth is slower than it is at the surface, the vulnerability of deep soil C under future climate scenarios is not well understood. In this project of the SFA, we aim to understand how long term warming affects microbial community composition and functioning, with a focus on decomposition of soil organic carbon (SOC) in deep soils. Microorganisms are responsible for both decomposition and formation of SOC. Changes in microbial community composition, functional diversity, activity, and physiology can determine how soil warming will alter soil carbon and nutrient cycling.

The SFA has established two soil warming experiments: At the Blodgett Forest Research Station, a coniferous forest located in the Sierra Nevada foothills and at the Hopland Research and Extension Center, an annual grassland. The treatment warms the whole profile +4°C above ambient while maintaining the natural temperature depth gradient. Samples across the soil profile were collected prior to and during warming for evaluating the effect on microbial community composition (16S rRNA and ITS gene sequencing) and microbial decomposition potential was assessed via extracellular enzyme activity measurements. To assess whether changes in microbial carbon use efficiency (CUE) occurred in response to warming, we carried out lab incubations with ^{13}C isotopologues of glucose and pyruvate. At both sites the activity of all enzymes declined with depth. However, at each site microbial biomass and enzyme activities increased due to warming (at all depths), consistent with the observation that soil from warmed plots had 2-3 fold higher respiration of the ^{13}C-labeled substrates. Microbial composition and diversity differed significantly across sites and depths, with bacteria hypothesized to have oligotrophic, and more efficient, growth strategies consistently increasing with depth. Under warming, some of these bacterial groups, such as the Verrucomicrobia in surface soils and Acidobacteria in deeper soils became more abundant. Fungal populations did not appear to be significantly affected by warming. After two years of warming (i.e., in short term incubations using soils collected two years after warming began), respiration of ^{13}C-labeled substrates increased 2-3 fold. Microbial CUE varied by depth and time; the initial decrease in the first six months period was followed by increase during the course of warming. Contrary to our expectations based on prior warming studies, microbial CUE increased in response to warming in both surface and deep soils. Our results show that in both forest and grassland soils, warming induced increases in microbial biomass at all depths, coinciding with greater extracellular enzyme activity that may generate positive feedbacks with SOM decomposition and respiration; however increases in CUE due to selection for organisms with more efficient growth strategies may off-set some of this potential for positive feedback.