Title: Ecological Factors Affecting Carbon Flow from Surface Litter

Deanna Lopez[1], Sanna Sevanto[1], Thomas Yoshida[1], and **John Dunbar**[1*] (dunbar@lanl.gov)

[1]Los Alamos National Laboratory, Los Alamos, NM

http://www.lanl.gov/org/padste/adcles/bioscience/bioenergy-biome-sciences/soil-carbon.php
http://www.lanl.gov/org/padste/adcles/bioscience/bioenergy-biome-sciences/environmental-microbiology.php

Project Goals: The LANL Genomic Science SFA is focused on microbial communities in surface soil horizons and their functional processes that influence soil carbon storage and release. The SFA examines soil carbon cycling under conditions of environmental change to understand the metabolic and ecological roles of fungi and bacteria in surface soils in two important temperate biomes – forests and arid grass/shrub lands. In both biomes, fungal and bacterial biomass is concentrated in shallow surface soil strata where C and N cycling are major processes. Advancing fundamental knowledge of soil communities within the context of altered environmental regimes will improve our ability to predict and possibly manage ecosystem contributions to global climate. This involves discovery of fundamental principles at different scales that influence the organization, interactions, and response of soil communities.

For the work presented in this poster, our ongoing aim is to improve understanding of biological factors that influence soil carbon storage. The concentration of soil carbon declines with soil depth but the residence time increases dramatically, ranging from a few years at the surface to thousands of years in mineral horizons a meter below the surface. There are differing views on the source of the carbon stored long-term in deep soil horizons. One view is that dissolved organic carbon (DOC) from decomposition of surface litter percolates to deeper horizons and binds to protective mineral layers. A second view is that processes linked to plant roots are the primary source. A third view is that both phenomena above contribute to long-term carbon storage in deep horizons, but the relative contribution of each process is unknown. At present, we are focusing on fluxes from decomposing surface litter, examining factors such as initial microbial biomass abundance, succession, and priority effects that control carbon flow and fate.

We found complex relationships between initial biomass abundance and carbon flux. In this work, sterile plant litter in sand microcosms was inoculated with dilutions of soil microbial communities from two different soils. After 30 days of litter decomposition, bacteria diversity correlated with the ten-fold reductions in initial microbial abundance. In contrast, the fungal community diversity at day 30 was similar across treatments, consistent with the outgrowth and convergence of fungal-dominated decomposer guilds. A surprising outcome was that CO_2 efflux rates varied with microbial community abundance. Despite rapid initial responses in all communities, lower initial community abundance resulted in extended period of reduced cumulative CO_2 release. Every ten-fold drop in initial biomass abundance resulted in a 6 to 13% reduction in cumulative CO_2 output over the incubation period, with variation depending on the source of the parent microbial community. These results may account for the inconsistent and conflicting outcomes reported in the recent body of studies on the "home-field advantage" hypothesis (i.e. plant litter is decomposed more efficiently by native communities than by foreign communities). Comparing outcomes from communities that differ in initial abundance provides insight into the role of less abundant species on carbon flow.

Funding statement: The information in this poster was supported by the U.S. Department of Energy Biological System Science Division, through a Science Focus Area Grant (2017LANLF260).