Role of geographic scale in likelihood of microbial-driven functional variation during litter decomposition

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Project Goal

1) Determine the magnitude of microbial driven variation in carbon flow (DOC & CO2), and the likelihood observing carbon flow variation over various geographic scales.
2) Establish how microbial communities vary in composition and carbon flow with distance.

Abstract

During litter decomposition, microbial communities release carbon as CO_2 and dissolved organic carbon (DOC). Some microbial communities produce greater DOC, while others produce more CO_2. In theory, this variation could be leveraged to increase soil carbon sequestration. A key starting point is to find natural communities that represent differences in carbon flow. Here, we examined the relationship of microbial-driven functional variation and geographic distance. Is a large geographic scale required to find substantial functional variation? We tested whether stochastic assembly, which occurs at local scales, could generate microbial communities with substantial functional variation or if larger scale, deterministic processes (climate and ecosystem gradients), were required to recover maximal functional variation. We tested this hypothesis with over 300 soil samples collected at a local (<10 m to 200 m) and regional scale (1 km to >300 km). Soil microbial communities were transferred to lab microcosms with sterile blue grama (*Bouteloua gracilis*) litter. Carbon flow (DOC and CO_2) was measured over 45 days of decomposition. The range of variation in DOC or CO_2 increased with physical distance across both collection scales However, only DOC variance was increased by including the regional scale. Variance in CO_2 reached similar levels at both the local and regional scale. Fungal and bacterial community composition were highly correlated with geographical distance at the regional, but not local scale. These findings suggest that the full range of microbially driven variation in CO_2 can be documented among samples collected at a local scale (<200m). Whereas DOC variation depends on larger differences in community composition, which tend to occur only at larger geographic scales, thus to recover the full range samples should be collected up to 150 km apart. These data guide sample collection for future projects that seek soil microbial communities driving variation in carbon cycling.

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