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Understanding the response of soil organic carbon to warming throughout the whole soil profile

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Over half of global soil organic carbon (SOC) is stored in subsurface soils (>30 cm). This deep SOC may generate a positive feedback with climate change if warming increases its turnover. However, most warming experiments have only focused on surface soils, where the mechanisms controlling SOC turnover may differ from those at depth. Thus, we have developed two experiments in California, USA to investigate the effects of warming (+4°C) on whole soil profiles. The first warms coniferous forest soils in situ (to 1.3 m), and the second warms grassland soils in field lysimeters (0.5 m deep). In both experiments, we have added highly 13C-enriched root substrates to multiple depths—15, 50, and 90 cm in the forest and 10 and 40 cm in the grassland. This labeled substrate will allow us to trace how the transformation of organic inputs (into CO_2 and microbial, particulate, and mineral-associated pools) differs with depth and to measure how native SOC decomposition at different depths is affected by root inputs. Specifically, these experiments will investigate (1) the temperature sensitivity of native SOC and added root substrate decomposition at different depths; (2) the effect of root carbon inputs on native SOC decomposition at different depths; and (3) interactions between warming and root C inputs on native SOC decomposition. We will present our experimental design and preliminary results from the first 4-6 months of warming and its impact on soil microclimate, soil respiration, and soil profile CO_2 concentrations. This study is one of the first to test whole-profile SOC responses to warming and root carbon inputs, and will enhance our understanding of carbon cycling mechanisms throughout the soil profile to improve predictions of soil's role a changing climate.