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The response of deeper soils to climate change

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Over half of global soil organic carbon (SOC) is stored in subsurface soils (>20 cm depth), but little is known about the vulnerability of this deeper SOC to climate change. Most soil warming experiments have either only warmed surface soils or only examined the response of the surface carbon dioxide flux, so the sensitivity of SOC at different soil depths and the potential of various soil depths to generate feedbacks to climate change is undetermined. As predictive models of terrestrial carbon storage move toward more mechanistic process representations, we need to understand how the carbon cycle differs across soil depths. We will present depth-explicit measurements of soil CO_2 production from three forest soil warming experiments including one of the first deep soil (>100 cm) warming experiments, at Blodgett Forest in California, and long-term climate manipulations at Harvard Forest (the Soil Warming and Nitrogen experiment; SWAN) and Hubbard Brook (the Climate Change Across Seasons Experiment; CCASE) in the Northeastern U.S. At Blodgett Forest, we found that all soil depths were similarly responsive to warming, and that soils deeper than 15 cm were responsible for 40% of the warming response. At Hubbard Brook, deeper soils have increased CO_2 production in response to warming and decreased CO_2 production in response to induced freeze thaw cycles during the winter. Furthermore, we have used respiration quotients (ratios of CO_2 produced to O_2 consumed) to connect changes in CO_2 fluxes to the carbon sources and processes that contribute to soil respiration. Our depth-explicit measurements have thus far demonstrated that despite longer turnover times than surface soils, deeper soils house an active and responsive carbon pool.