Title: **Soil Carbon Cycling and Root Dynamics across Rainfall and Soil Fertility Gradients and with Drying in Lowland Tropical Forests of Panama**

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Project Abstract (400word):

Humid tropical forests contain some of the largest soil organic carbon (SOC) stocks on Earth. Much of this SOC occurs at depth in the soil profile, but controls over SOC storage and depth distributions, such as root turnover, climate, and soil properties, remain poorly understood. To address this, we measured SOC storage, soil C losses via respiration, fine root dynamics, soil nutrients, and aboveground characteristics across rainfall and soil fertility gradients on the Isthmus of Panama. We hypothesized that infertile soils have greater allocation of plant C to fine root biomass relative to fertile soils, and this corresponds to larger soil C stocks in infertile soils because of greater root biomass inputs. We also hypothesized that fine root biomass and soil C stocks are less vulnerable to drying in infertile soils relative to fertile soils, because of more conservative root growth strategies. We used 50 1-ha plots in distinct forests on different geological substrates for landscape-scale assessments, and we used four of these sites for a drying experiment. All sites are adjacent to long-term forest monitoring plots maintained by the Smithsonian Tropical Research Institute. The drying experiment was established in 2018, and uses ~50% throughfall diversion structures of clear roofing over 10x10m plots to divert throughfall out past 50cm-deep plastic-lined trenches (n=4).

We found that root biomass was the strongest predictor of soil C stocks to 1m depths, with additional predictive power provided by soil clay content, rainfall, and extractable base cations. We also found that the depth distributions of fine roots were inversely related to depth distributions of SOC. That is, infertile soils had relatively large stocks of root biomass in surface soils (0-20cm), and large subsoil C stocks (40-100cm). Soil respiration varied greatly with season across the rainfall gradient. The magnitude of increased respiration during the wet versus dry season was correlated with soil available resin phosphorus, extractable base cations, and soil moisture variation. In the drying experiment, throughfall exclusion suppressed soil respiration during the transition from the dry to wet season, and suppressed surface fine root growth (0-20cm), similar to suppressed surface fine root growth during the dry season. These results suggest that global change effects on surface root growth in tropical forests might have cascading effects on subsurface SOC storage, affecting the large stocks of SOC contained in tropical forests. More research is needed to characterize the subsoil properties driving deep SOC storage in tropical soils.