**Title**: **Tropical Forest Response to a Drier Future: Synthesis and Modeling of Soil Carbon Stocks and Age**

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**Project Abstract**:

Tropical forests account for over 50% of the global terrestrial carbon sink and 29% of global soil carbon, but the stability of carbon in these ecosystems under a changing climate is unknown. Recent work suggests moisture may be more important than temperature in driving soil carbon storage and emissions in the tropics. However, data on belowground carbon cycling in the tropics is sparse, and the role of moisture on soil carbon dynamics is underrepresented in current land surface models limiting our ability to extrapolate from field experiments to the entire region. We measured or attained data for soil carbon stocks and radiocarbon (14C) values of profiles from over 40 sites spanning 12 pan-tropical regions. Our sites represent a large range of moisture, spanning 710 to 4200 mm of mean annual precipitation (MAP), and include Alfisols, Andisols, Inceptisols, Oxisols, and Ultisols. We found a large range in soil 14C profiles between sites, and in some locations, we also found a large spatial variation within a site. MAP explains some of the variation in soil 14C profiles and carbon stocks, with smaller C stocks and younger soil carbon in drier forests. However, differences in soil type contribute substantially to observed variation across the dataset and with constrained gradients in moisture and parent materials in Panama. We are exploring the influence of controlling factors in manipulation experiments and constrained gradients of precipitation, soil type, root inputs, geomorphology, and landuse on carbon storage and longevity through collaborative site-specific studies. For example, conversion of primary forests to pasture in the Ucayali region of Peru caused a loss of young soil carbon in 10-20-year-old pastures. Reforestation of agricultural lands restored young soil C stocks after 15 years, but these forests retain a legacy of lost carbon. Site-level runs of ELM v.1 and integration with a reduced complexity model (SoilR) are being used to evaluate model representation of soil C processes, including vertically-resolved carbon transfer rates, root inputs, and decomposition. In comparing measured soil C stocks and 14C profiles to data generated from ELMv1, we found

that the model continues to overestimate carbon stock and underestimate turnover time. Finer resolution runs of ELMv1 and site-level model-data comparisons will provide more insight and be used to assess the role of climate vs other soil (e.g., soil type and parent materials) and ecosystem factors (e.g. rooting depth) in driving vertically-resolved measured and modeled soil carbon pools and ages.

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