Tropical Forest Response to a Drier Future: Turnover Times of Soil Organic Matter, Roots, Respired CO_2, and CH_4 across Moisture Gradients in Time and Space

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Globally, tropical forests account for over half of the carbon sequestered on land each year and nearly 30% of the carbon stored in soil, but belowground carbon feedbacks to climate change are unknown. Recent research suggests moisture may be particularly important in driving soil carbon storage and emissions in the tropics but that the role of moisture is underrepresented in current models. Data on belowground carbon cycling in the tropics are sparse, making extrapolation from field experiments to the tropics as a whole uncertain and limiting our ability to test and improve model performance. The objectives of this research are to 1) investigate how moisture regime and seasonality shape belowground carbon age and transit time in tropical forests and 2) identify specific areas for improvement in tropical land carbon modeling by Earth System Models. In this research, natural amounts of radiocarbon (^{14}C) will be used to trace carbon as it moves into, within, and out of belowground carbon pools to investigate how moisture regime and seasonality shape belowground carbon cycling in tropical forests with differing moisture regimes. Field data will be compared to belowground carbon variables modeled for study sites with DOE's new Earth System Model, the Accelerated Climate Model for Energy (ACME). Finally, for each field site, different soil carbon model structures, environmental drivers, and soil characteristics will be assessed to identify the critical next steps in model development. This is the first cross-site field study on belowground carbon dynamics spanning the entire range of moisture regimes experienced by tropical forests. This work will inform future research and drastically improve models of carbon cycling in the tropics, reducing uncertainty in tropical forest carbon feedbacks to climate.

This research was selected for funding by the Office of Biological and Environmental Research.
