Title: Do tropical forest trees have limited water sources? Plant water sourcing depth across the neotropics.

Cynthia Wright[1*], Rutuja Chitra-Tarak[2], Aitor Gimenez[2], Bruno Gimenez[3,4], Robinson Negrón-Juárez[5,] Brent Newman[2], Kurt Solander[2], Jeffrey Warren[1]
[1]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN
[2]Earth and Environmental Sciences Division, Los Alamos National Laboratory, Los Alamos, NM
[3]National Institute of Amazonian Research, Manaus, Brazil
[4]Smithsonian Tropical Research Institute, Panama City, Panama
[5]Lawrence Berkeley National Laboratory, Berkeley, CA

Contact: wrightcl1@ornl.gov
Project Lead Principal Investigator (PI): Jeffrey Chambers, Berkeley Lab
BER Program: ESS
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Project Abstract:
Plant water availability and sourcing depth is central to understanding vegetation responses and coping mechanisms to water stress and increases in drought. Stable isotopes of water ($\delta^{18}O$ and $\delta^{2}H$) can be powerful tracers to investigate effective tree rooting depth when combined with site- and species-specific information like soil type, soil water and water table dynamics, and plant hydraulic traits. Yet, such studies are limited in the humid tropics, especially considering that it is difficult to time water isotope sampling with a significant dry-down which creates an isotopic separation of water sources across soil profile. Moreover, some of the foundational water isotope work conducted in the tropics generally relied on only one isotope tracer, which limits Bayesian and other mixing-model frameworks aimed at quantifying source water contributions. As a first step towards overcoming some of these challenges, we conducted repeated stem and soil water sample collections at several core NGEE-Tropics sites in the neotropics, which also have long-term hydrological or ecological data. These sites include the ZF2 ecological experiment station in the central Amazon, Brazil and Parque Natural Metropolitano and Barro Colorado Island in Panama. Other sites for which data has been collected opportunistically include the San Lorenzo site in Panama, and Mulehole in India. While it is thought that shallow soil water is sufficient to sustain forests during the dry season, here we summarize recent finding that for the ZF2 and BCI sites, the forest stand generally shifts to deeper soil water during periods with limited rainfall, suggesting that at least for some canopy-dominant species, which may drive ET patterns, deep soil water help trees cope with or all together avoid water stress. Other related work has reported that species across a rainfall gradient in Panama exhibit very little difference in leaf hydraulic traits within sites (see WP 1.2). We also report on preliminary data including the ecohydrological dynamics of soil moisture and groundwater for ZF2, soil moisture for BCI and ELM-FATES based modeling of soil moisture dynamics in Paracou, French Guiana. We discuss steps forward regarding water isotope analysis of samples collected across neotropical sites during dry periods in 2019-2022. This includes synergies with WP 1.3 linking leaf spectral and trait data to plant water isotope data, and MODEX efforts to validate inverse rooting-depth models of pantropical sites.