

Title: Soil moisture thresholds explain a shift from light-limited to water-limited sap velocity in the Central Amazon during the 2015-16 El Niño drought

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Project Abstract:

Transpiration is often considered to be light- but not water-limited in humid tropical rainforests due to abundant soil water, even during the dry seasons. The record-breaking 2015-16 El Niño drought provided a unique opportunity to examine whether transpiration is constrained by water under severe lack of rainfall. We measured sap velocity, soil water content, and meteorological variables in an old-growth upland forest in the Central Amazon throughout the 2015-16 drought. We found a rapid decline in sap velocity ($-38\% \pm 21\%$, mean \pm SD.) and in its temporal variability (-88%) during the drought compared to the wet season. Such changes were accompanied by a marked decline in soil moisture and an increase in temperature and vapor pressure deficit. Sap velocity was largely limited by net radiation during the wet season; however, it shifted to be primarily limited by soil moisture during the drought. The threshold in which sap velocity became dominated by soil moisture was at $0.33 \text{ m}^3/\text{m}^3$ (around -150 kPa in soil matric potential), below which sap velocity dropped steeply. Our study provides evidence for a soil water threshold on transpiration in a moist tropical forest, suggesting a shift from light limitation to water limitation under future climate characterized by increased temperature and an increased frequency, intensity, duration and extent of extreme drought events.