Poster #9-13

Optimal Crown Temperature of Basal Stem CO_2 Efflux in Canopy Dominant Trees in the Central Amazon

Kolby Jardine, [1,2*], Leticia Oliveira Cobello[2], Bruno Gimenez[2], Niro Higuchi[2], and Jeffrey Chambers[1,2,3]

[1]Lawrence Berkeley National Laboratory, Berkeley, CA
[2]National Institute for Amazon Research (INPA), Manaus, Brazil
[3]Department of Geography, University of California Berkeley, Berkeley, CA

Contact: Kjjardine@lbl.gov

BER Program: TES
Project: NGEE-Tropics
Project Website: https://ngee-tropics.lbl.gov/

Stem respiration is estimated to represent 20-30% of autotrophic respiration, but its response to environmental drivers like temperature remains unclear. Although respiration sources and CO_2 transport in the transpiration stream are known to increase with temperature, their combined influence on diurnal stem CO_2 efflux (E_S) in the tropics remain poorly understood.

In this study, we show that basal E_S (1.3 m) from three canopy dominant trees in a mature tropical ecosystem in the central Amazon is tightly correlated with crown temperature (27-31 m) over fast (5 min), medium (hourly), and diurnal time scales. Transient variations in daytime crown temperatures caused by the passing of clouds overhead were accompanied by rapid variations in basal E_S.

Elevated crown temperatures during the daytime were accompanied by high sap velocities and reduced basal E_S. In contrast, during the night and rainy conditions, crown temperatures and sap velocities reached minimum values while basal E_S reached maximum values.

The results show that E_S was depressed when crown temperatures exceed 24-28.5°C, potentially reflecting an optimum crown temperature where stem CO_2 sources reach a maximum relative to stem CO_2 sinks (e.g. transport in the transpiration stream). We suggest this optimal temperature may be useful as a new benchmark for land models that mechanistically link autotrophic respiration and transpiration. In contrast to current global models, which predict higher E_S with temperature, our results imply that warmer conditions lead to reduced E_S and increased transport in the transpiration stream, potentially enhancing internal CO_2 re-assimilation and consequently carbon use efficiency and photo-protection during climate warming.