NAME: Jeffrey Chambers
ORGANIZATION: LBNL
PROGRAM AFFILIATION: TES
ABSTRACT TITLE: Toward a Predictive Understanding of BVOC Emissions from Tropical Forests

ABSTRACT: Emission of biogenic volatile organic compounds (BVOCs) from the Amazon Basin impacts key atmospheric processes including aerosol and cloud lifecycles, which in turn influences terrestrial physiological processes through changes in precipitation, temperature, and the quality of incoming light for photosynthesis. Our ability to represent these coupled biosphere-atmosphere processes in Earth system models (ESMs) is constrained by an extremely poor understanding of the identities, quantities, and seasonal patterns of BVOC emissions from tropical forests and a mechanistic understanding of their plant physiological and environmental controls. To fill these knowledge gaps and improve predictive ESMs, the Green Ocean Amazon Terrestrial Ecosystem project (Geco) is designed to evaluate the strengths and weaknesses of leaf and ecosystem-scale BVOC emission algorithms for forests near Manaus, Brazil. We first evaluated BVOC emission algorithms by measuring leaf BVOC emissions and assimilated carbon responses of a tropical species (mango, *Mangifera indica*) in a controlled, laboratory experiment. We applied a novel $^{13}CO_2$ labeling technique to observe, for the first time, the dynamics of stored versus recently assimilated carbon sources for BVOC emissions and its dependencies on light and temperature. The results suggest an important functional role of isoprene under high temperature stress where stored carbon sources increasingly dominate diminishing photosynthetic sources to sustain high isoprene emissions. Evaluation of the Community Land Model (CLM), which includes the Model of Emissions of Gases and Aerosols from Nature (MEGAN), over the Central Amazon region, showed a stronger response of isoprene emissions to varying temperature than light. Additional sensitivity tests with MEGAN-CLM (internal CO_2, soil moisture, plant functional type) will be used to develop a detailed Geco field study near Manaus, Brazil. This BVOC field study, will in turn, be used to recommend parameter and structural changes to MEGAN-CLM.

The Geco field study will;

1) Take advantage of extensive historical forestry datasets together with unique canopy access in the ZF2 forest preserve Amazon field site with walkup flux towers, a canopy access lift, and canopy walkways**.** Using environmentally controlled leaf chambers, we will study large numbers of tree species for **relationships** between environmental variables (light and temperature) and plant physiological variables (photosynthesis, transpiration, conductance, and emissions of BVOCs)**.**
2) Apply positional specific ^{13}C-labeled metabolite feeding to track intra and extra cellular carbon sources into BVOC biosynthesis and emission. BVOC carbon source(s) dependencies on envirionmental variables (light, temperature) will be evaluated using novel positional-specific ^{13}C-metabolite labeling techniques with a variety of BVOC precursur substrates including $^{13}CO_2$, $H^{13}CO_3^-$, ^{13}C-pyruvate, ^{13}C-ethanol, ^{13}C-acetate, and ^{13}C-glucose.
3) Estimate within and above canopy BVOC fluxes from high vertically resolved ambient concentration measurements in primary rainforest canopy in the central Amazon in relation to environmental drivers (light, temperature, soil moisture) in order to elucidate the role of BVOC biosynthesis and emission processes in response to seasonal climate variables.