PROJECT TITLE: Unravelling the key thermal strategies of tropical forest trees

Project Supervisor: Lina Mercado, University of Exeter, Geography

Co-Supervisor: Tyeen Taylor, University of Exeter, Geography

Project Enquiries: l.mercado@exeter.ac.uk

Project keywords: tropical forest, climate change, leaf thermoregulation, evapotranspiration

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Figure 1 Sapflow sensor at one experimental site

Project description: Tropical Mountain cloud forests are biodiversity hotspots, and predicting their future requires an understanding how they will respond to a warming climate. Global warming increases the risk of extreme leaf temperatures causing heat stress and loss of plant productivity which can culminate in forest dieback and alterations in ecosystem function. Plants can reduce the risk of foliar heat damage via two main strategies: avoidance or tolerance to high leaf temperatures, T_{Leaf}. This comprises: i) leaf thermoregulation (avoidance) to cool leaves mainly via transpiration. Heat avoidance can also be attained through alteration of the amount of radiation received via modification of leaf size, angle, orientation or absorptivity; and ii) photosynthetic heat tolerance, which can be further increased via biochemical mechanisms to avoid oxidative stress under high T_{Leaf}. The plasticity in thermoregulation and thermal tolerance traits further reduces the risk of heat damage. It remains unclear whether species use a single or multiple strategies, what the extent of plasticity of these traits is, and what the most effective overall strategy is under heat stress.

Project Aims and Methods The overall aim of the project is to determine thermoregulation strategies of tropical trees using a newly collected data set from a unique experimental facility in the Colombian Andes as part of the NERC funded project Trop-Heat. The primary data to be analysed during this REP consists of continuous measurements of tree sapflow (vertical transport of water) from tropical Andean tree species across two experimental climate-warming treatments during fieldwork in Colombia in Jan-Feb 2024. Additional datasets include leaf structural characteristics that influence leaf temperature. The successful candidate will analyse the data set which can be used to answer various research questions developed by the placement student and the supervisory team. There is room for the candidate to bring their own ideas and influence research direction.

Candidate requirements We seek a highly motivated candidate with strong numerical skills with data analysis and coding experience in either R (preferred), python or similar programming languages, preferably with some understanding of plant carbon-climate interactions**.** Remote working from anywhere in the UK is possible.

Background reading: Fauset et al 2018, PCE,41:1618, Cox et al 2023, New Phytol 238:2329 Tarvainen et al 2022, New Phytol, 233:236. https://andeantreewarming.wordpress.com

Approximate Work Schedule Weeks 1 -2: Familiarise with the topic data sets (sapflow, climate variables, leaf traits), read about calculation of transpiration from sapflow data, prepare initial analytical code. Week 3: Together with supervisory team, devise research questions, begin analyses. Weeks 4-7: Bulk of the analysis, preparation of research outputs. Week 8 Preparation of final report and presentation with key figures addressing research questions. The student will join weekly meetings with supervisors, fortnightly meetings with the Trop-Heat research group (Colombia and UK teams) and fortnightly meetings with the wider from the research group of Lina Mercado, that meets jointly with other two academies in Geography (Prof S. Sitch and Prof P. Friedlingstein) with ~ 15 early career remembers. Outcomes of the work together with further analysis will lead to publication and student will be invited for authorship.