Title: **Unraveling the Mechanisms of Below- and Aboveground Liana-Tree Competition in Tropical Forests**

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Project Abstract: Trees and lianas dominate the canopy of tropical forests and comprise the majority of tropical aboveground carbon storage. These growth forms respond differently to variation in climate and resource availability, and their responses to future climate change are poorly understood. The overarching objectives of this project are to carry out an observational campaign to advance our understanding of liana traits and strategies, develop a liana-enabled forest dynamics model that leverages our observations, and to engage with the Earth System Modeling (ESM) community to plan for the eventual inclusion of lianas into ESMs. Here, we report on four activities which have brought us closer to meeting these objectives. (1) We have constructed trait distributions for lianas and trees, and identified those traits which differed between lianas and trees. The most striking difference was found for sapwood-specific hydraulic conductivity, which was three times larger in lianas than trees. We incorporated these results into a mechanistic but simple model of liana-tree couplet, and subjected the model to different tropical hydroclimate scenarios. Due to differences in hydraulic conductivity, the model indicated that lianas are much more susceptible than trees to reaching a hydraulic threshold for viability by 2100. (2) We incorporated lianas into the TROLL forest dynamics model and developed new schemes for leaf production and turnover. TROLL represents the three-dimensional canopies of trees and lianas, discretized into 1-meter-cubed voxels. Thus, for a given host tree canopy, our scheme specifies where it is that lianas prefer to grow new leaves. We have carried out a sensitivity analysis and variance decomposition with respect to model parameterization. (3) We are quantifying liana demography in two sets of plots in Guanacaste, Costa Rica. These plots were established between 2008-2016 and span successional and edaphic gradients. Some of the plots are being subjected to nutrient fertilization and/or throughfall exclusion. Current measurements include tree and liana diameter growth, death, and recruitment. Further, each year we record an index of liana load on each tree, using a 0-3 point ordinal scale. We are currently analyzing demographic rates as a function of liana load. (4) We are measuring litterfall and fine root production in the plots. We installed 30 cm deep root ingrowth cores in 18 plots in December 2020. We are further partitioning fine root production

into lianas versus trees using molecular analyses. We have begun preliminary tests to optimize the primers and PCR conditions for the molecular analyses.