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

David Medvigy,[1*] Jennifer Powers,[2] Peter Tiffin,[2] Jérôme Chave,[3] Isabelle Maréchaux[4]

[1]University of Notre Dame, Notre Dame, IN;
[2]University of Minnesota, St. Paul, MN;
[3]Le Centre National de la Recherche Scientifique, Toulouse, France;
[4]Institut National de la Recherche Agronomique, Montpellier, France

Contact: dmedvigy@nd.edu

Project Lead Principal Investigator (PI): David Medvigy

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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 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 six activities from the past year. (1) We measured and conducted meta-analysis of liana traits. On average, we found marked differences between lianas and trees in terms of their hydraulic traits and xylem anatomical traits. We also identified significant variation in hydraulic traits across liana species. (2) We incorporated these results into a model, 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. (3) We measured tree growth and liana colonization status of over 1,700 trees at a study site in Guanacaste, Costa Rica. We found that the number of colonized trees is increasing and that heavily infested trees have lower relative growth rates that other trees. Liana colonization also impacted the relationship between tree growth and rainfall. (4) We incorporated lianas into the TROLL forest dynamics model and developed new schemes for leaf production and turnover. We have carried out a sensitivity analysis and variance decomposition with respect to model parameterization. We found that the sensitivity to the leaf production scheme is greater than the sensitivity to leaf turnover. (5) We implemented liana-enabled forest dynamics in TROLL. These dynamics include the ability of lianas to colonize an arbitrary number of trees in its neighborhood and the ability of trees to shed lianas. (6) 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 and May 2021 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.