Poster #9-39

Extrapolating Ecosystem Processes of Seasonally Dry Tropical Forests Across Geographic Scales and into Future Climates

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BER Program: TES
Project: University Award

Seasonally dry tropical forests (SDTFs) experience a pronounced dry season lasting 3 to 7 months, and once accounted for approximately 40% of all tropical forest. Dry forests are understudied compared to tropical rainforests, and are poorly represented in earth system models. It is unknown whether SDTFs are uniquely vulnerable or resilient to global environmental changes including climate change and increasing drought[1]. We hypothesize that the responses of STDFs to global change depend critically on belowground processes and nutrient availability, but we lack empirical data to verify this. Our objectives are to quantify how above- and belowground processes mediate the responses of SDTF carbon dynamics to environmental change, and to incorporate that understanding into two state-of-the-art models, ED2 and ACME. To do so, we are using an interdisciplinary approach that integrates: 1) field observations of ecosystem processes and plant functional and hydraulic traits across a range of dry forest sites in Costa Rica, Mexico, Puerto Rico, and Colombia, 2) forest-scale experiments that manipulate water and nutrient availability in Costa Rica, and 3) model simulations that quantify sensitivity of ecosystem carbon cycling to external forcings. Ultimately, our combined measurement and modeling approach will elucidate controls on C cycling in SDTFs and yield improved models for the global change research community. Our empirical studies are yielding interesting results. First, results from our nitrogen and phosphorus addition experiment show rapid responses of plant symbionts to nutrient addition: legume nodule production increased in plots fertilized by P, but not N+P or N alone, and root colonization by arbuscular mycorrhizal fungi decreased in the N+P treatment only. Plant species displayed a range of stem growth responses to factorial N and P fertilization. Second, we established a large-scale 50% throughfall exclusion experiment that is crossed with a complete nutrient fertilization treatment. Stem growth of the six focal species responded individualistically to the treatments. Many species showed reductions in stem growth with drought; however, in several species fertilization modulated the responses to drought. Five out of six species showed increased growth in the fertilization treatment. Collectively these studies suggest that nutrient availability is an important constraint on tropical dry forest ecosystem processes and responses to rainfall reduction. Our third project provides detailed data on how soil biogeochemistry and forest growth varies across the range of Neotropical dry forests. These data suggest enormous variation in the structure and ecosystem processes among forests and serve as the basis for modeling.

References: [1]Allen, K., J. M. Dupuy, M. G. Gei, C. M. Hulshof, D. Medvigy, C. Pizano, B. Salgado-Negret, C. M. Smith, A. Trierweiler, S. J. Van Bloem, B. G. Waring, X. Xu, and J. S. Powers. 2017. Will seasonally dry tropical forests be sensitive or resistant to future changes in rainfall regimes? Environmental Research Letters 12:023001.