Poster #119

Understanding the Effects of Drought and Nutrient Deposition on Tree Growth in Tropical Dry Forests

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Tropical ecosystems experience dramatic changes in their dynamics due to climatic variability, and seasonally dry forests appear to be particularly vulnerable to this. A main reason of the apparent vulnerability of tropical dry forests is the susceptibility of its tree species to shifts in precipitation regimes. For instance, a recent drought event in our study sites in Costa Rica led to an increase in forest-wide mortality rates from 3% to 6.16% per year. At the same time, tree species responses to rainfall variability may vary as a function of environmental conditions, such as nutrient availability. As drought events increase in intensity and length within tropical regions, the accurate representation of tropical dry forests' responses to drought in dynamic vegetation models remain low. Thus, the overall goal of my doctoral dissertation is to understand the physiological mechanisms driving tropical tree species responses to drought events, in order to provide empirical data to parametrize vegetation models. Even though I am in my first year of graduate school, I have been working on this project as a technician for a year prior to starting my PhD studies with Dr. Powers at the University of Minnesota. Under the framework of our collaborative DOE funded project "Tropical Dry Forests Responses to Changing Climate and Nutrient Availability", I got involved in the design, establishment, and ongoing operation of a large experiment that manipulates rainfall and nutrients in plantation forests at the Horizontes Experimental Forestry Station, in Guanacaste, Costa Rica. This experiment will form the core of at least two of my thesis chapters. In the field site, we selected six tree species present in mixed timber plantations belonging to four functional types (DS: deciduous stem-succulent, D: deciduous, BD: brevi-deciduous and E: evergreen) described by our working group using a modelling approach. Then, we established 16 plots divided in four treatments (drought, nutrient addition, drought + nutrient and control) using 200 trees. At the same time, we apply nutrients twice per growing season as a complete fertilizer and drought is imposed as 50% through-fall exclusion by construction of large panels that route water off from the plots. We also track soil moisture at two depths (10 and 40 cm) in five locations within each of the 16 plots in order quantify the magnitude of the treatment effects on this critical variable. Additional measurements include fine root production, canopy phenology by using leaf area index, soil respiration, tree growth and water status. Thus far, we have found a clear effect of our drought treatments in soil moisture, which confirms the effectiveness of our rainfall exclusion structures. We expect diminished effects of drought conditions on all tree species due to the interaction with nutrient additions, as a nutrient-rich environment may favor water use efficiency. At the same time, we expect smaller effects of the drought treatment in evergreen species as their resource-use conservative strategy might favor them to withstand drought stress. However, nutrients might allow other functional groups' species (DS, D & BD) to cope with changes in water availability. At the end, our work will fill out a gap in current knowledge required to increase the accurate representation of tropical dry forests in dynamic vegetation models.