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# Temporal variation in microclimatic conditions in relation to vegetation type and structure in two tropical dry forest landscapes: implications for secondary succession

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It is thought that microclimate interacts strongly with ecosystem functioning and community assembly during forest succession. However, in the case of tropical dry forests, there have been very few observations of how microclimate, and soil temperature and moisture in particular, change over successional time. The most complete study to date concluded that soil moisture is lower in early successional tropical dry forest than in older forests. However, this result was largely driven by one very young study in the chronosequence. Thus, it is not known how generalizable this pattern is across early successional dry forests.

In this study, we investigated temporal patterns of microclimatic variables in different land uses in dry forest regions in both Costa Rica and Puerto Rico. We selected three replicate patches in four different vegetation types that represent potential successional trajectories: open land with few trees dominated by C4 pasture grasses and/or herbaceous plants, shrub land with more short statured trees, but understories dominated by grass and/or forbs, forest that were mature secondary forests, and tree plantations of different ages and species. In all plots, we quantified tree basal area, leaf area index, and soil texture. We also measured fine root stocks in the Costa Rican plots. We then made weekly to monthly soil moisture measurements and frequent soil temperature measurements using iButtons. These measurements were complemented by model simulations of secondary succession using the Ecosystem Demography 2 model.

Our soil moisture data from Costa Rica showed little evidence that younger sites are drier on average; however, they do exhibit a larger range of soil moisture over the course of a wet season. By contrast, soil temperatures were larger in open sites than in forests or plantations, mainly because of larger daytime temperatures. We found no difference in interception based on pluviometer data. Model simulations showed simple, monotonic temporal trends in microclimatic variables. As the simulated plots aged, air and soil temperatures declined, soil water declined, relative humidity increased.

These results have implications for successional theory, which is based on the assumption that microclimatic differences are one of the major processes that filters functional traits, and hence changes in community composition. In contrast to previously published results, our most open stands were not observed to exhibit (on average) the particularly harsh microclimatic conditions that have been associated with “conservative” plant traits. Going forward, numerical models can be used to tease apart the role of changes in different microclimate variables on successional trajectories, including the effects of different average microclimate versus different microclimatic extremes.