Landscape-scale And Spatially Explicit Representation of vegetation dynamics and ecosystem carbon stocks in a hyperdiverse tropical forest ecosystem (LASER)

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Abstract (100–500 words)

Tropical vegetation dynamics and ecosystem carbon (C) stocks typically vary with local topography and forest disturbance history. Yet, neither remote sensing nor vegetation modeling captures the underlying mechanistic processes determining ecosystem functioning and therefore the resulting estimates often do not match field observations of vegetation C stocks, especially so in hyperdiverse tropical forest ecosystems. This mismatch is further aggravated by the fact that multiple interacting factors, such as climatic drivers (i.e., temperature, precipitation, climate seasonality), edaphic factors (i.e., soil fertility, topographic diversity) and diversity-related parameters (i.e., species composition and associated plant functional traits) in concert determine ecosystem functioning and therefore affect tropical forest C sink-strength. Here, we propose a novel framework designed for integrating in-situ observations of local plant species diversity with remotely sensed estimates of plant functional traits, with the goal to deduce parameters for a recently developed trait- and size-structured demographic vegetation model. Plant-FATE (Plant Functional Acclimation and Trait Evolution) captures the acclimation of plastic traits within individual plants in response to the local environment and simulates shifts in species composition through demographic changes between coexisting species, in association with differences in their life-history strategies. Our framework may be used to project the functional response of tropical forest ecosystems under present and future climate change scenarios and thus should have crucial implications for assisted restoration and management of tropical plant species threatened by extinction.