Title: **Vertical and horizontal distributions of tree density, tree size, crown size and crown packing over the Brazilian Amazon from airborne lidar data**

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Project Abstract:
Tropical trees adapt the shape and size of their crowns in response to highly competitive environmental variations. Tree density and crown packing regulate light penetration and forest proprieties such as biological diversity, growth, competition, mortality and recruitment. It has been suggested that tropical tree crowns are extremely heterogeneous as canopy packing efficiency critically depends on the biological diversity and on within-species crown plasticity. Natural and anthropogenic disturbances (e.g. lightning, logging) also play a major role on tree demography and tree crown diversity. However, our knowledge of the relationship between canopy structure and the tropical ecosystems function is limited. Field measurements provide important data on tree diversity and demographics but measurements of three-dimensional forest structure from the ground are difficult and scarce.
Using extensive airborne lidar data, we extracted individual tree crowns (Ferraz et al., 2016) from 470 samples (6.25ha) located in *terra firme* forests within the Brazilian Amazon. The samples were selected from a collection 558 transects (15 km x 0.5km) of airborne lidar data acquired in 2016 in a random design.
We examined patterns of tree density and crown packing across gradients of forest cover, soils topography and climate. Specifically, we compare intra-plot and inter-plot variability in tree density, tree size (height and crown dimensions), tree competition, crown packing, and crown plasticity. By analyzing the lidar derived three-dimensional crowns maps, we test whether increased canopy packing primarily occurs through vertical stratification or horizontal space filling. We use coincident field inventory over a limited number of sites to study the response of species richness to tree competition, crown packing and plasticity.
Our datasets provide a unique Amazon-scale tree crown structural benchmark to study role of forest structure biogeochemical and climatic processes. Chronosequence analyses (e.g. time since last disturbance) enable the study of competing plant functional traits that drive vertical and/or horizontal crown packing, govern forest light conditions and favor forest regenaration and carbon storage.