Lidar tree crown detection reveals new patterns of tree density, height and volume in the Brazilian Amazon

Ferraz, A.; **Saatchi, S.**; **Keller, M.**; **Longo, M.**; **Ometto, J. P.**

The spatial arrangement of tree crowns regulates light penetration and ecosystem properties and functions such as biological diversity, growth, competition, mortality, and recruitment. The variability of tree density and canopy structure across space and time are not well known, especially in tropical environments such as the Amazon forest where there is a large diversity of tree species with complex crown shapes. Field measurements provide important data on tree diversity and demographics but measurements of three-dimensional forest structure from the ground are extremely limited. 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. For trees > 10 m tall, we found an average tree density of 403 trees ha^{-1} (range 86 to 630). The highest average tree density was located in the Japurá-Solimoes-Negro moist forest ecoregion (464 trees ha^{-1}, range 341 to 621) with Guiana shield moist forest having the lowest average (315 trees ha^{-1}, range 290-336). The lidar survey revealed extremely high trees in the Guiana shield where the tallest individual measured 88.5 meters, a maximum for the Amazon forest. We modeled basal area (BA) based on lidar-derived height and crown area using a neotropical allometric equation. The average BA was 25.7 m^2 ha^{-1} (range 5.9 to 41.8). Guiana shield forests had the largest average BA (37.7 m^2 ha^{-1}, 33.7 to 41.8) with Mato Grosso seasonal forest showing the lowest BA with 15.59 m^2 ha^{-1} with an average tree density of 402 trees ha^{-1}. The BA in Mato Grosso ranged from 4.1 to 26.2 m^2 ha^{-1} for samples with tree densities from 156 to 517 trees ha^{-1}, respectively. We further examined tree size along edaphic, topographic and climate gradients across the Amazon.

Ferraz, A., Saatchi, S., Mallet, C., Meyer, V., 2016. Lidar detection of individual tree size in tropical forests. Remote Sens. Environ. 183, 318-333. doi:10.1016/j.rse.2016.05.028

Publication:
American Geophysical Union, Fall Meeting 2019, abstract #B23E-03

Pub Date:
December 2019

Bibcode:
2019AGUFM.B23E..03F

Keywords:
0410 Biodiversity; BIOGEOSCIENCES; 0476 Plant ecology; BIOGEOSCIENCES; 1615 Biogeochemical cycles; processes; and modeling; GLOBAL CHANGE; 1616 Climate variability; GLOBAL CHANGE