National Aeronautics and Space Administration

Amazon forest structural diversity estimated using field inventory plots, airborne lidar and GEDI spaceborne lidar

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RESEARCH GAP

Field inventories of tropical forests are sparse and vast areas have no representative inventory information. Reliance on sparse field measurements can lead to large uncertainties when extrapolating to vast regions such as the Amazon forest. The advent of airborne and spaceborne lidar expands the coverage from local to regional and continental measurements of forest structural properties.

OBJECTIVE

To produce Amazon-wide estimates of forest structure (aboveground biomass, basal area, leaf area index, and stem number density) by integrating information from forest inventory plots, airborne lidar and GEDI (Global Ecosystem Dynamics Investigation) spaceborne lidar using a two-step approach.

DATA

GEDI shots overlapping airborne lidar
11,280

~250,000,000
GEDI quality shots over the Amazon

1,040
forest inventory plots overlapping airborne lidar

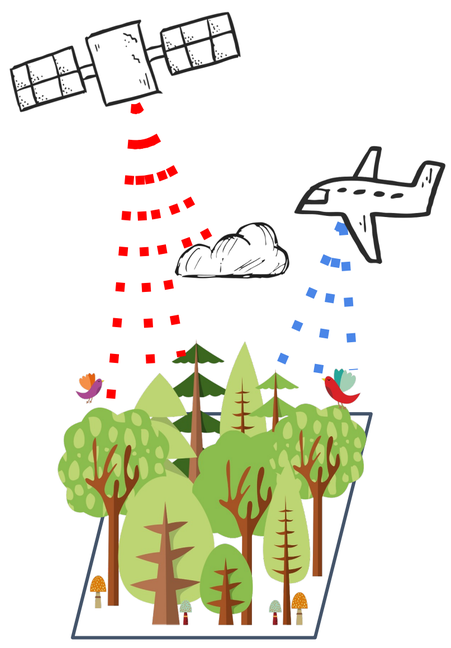

Figure 1. Nested input data used in estimating forest structural diversity at the Amazon biome scale.

METHODOLOGY

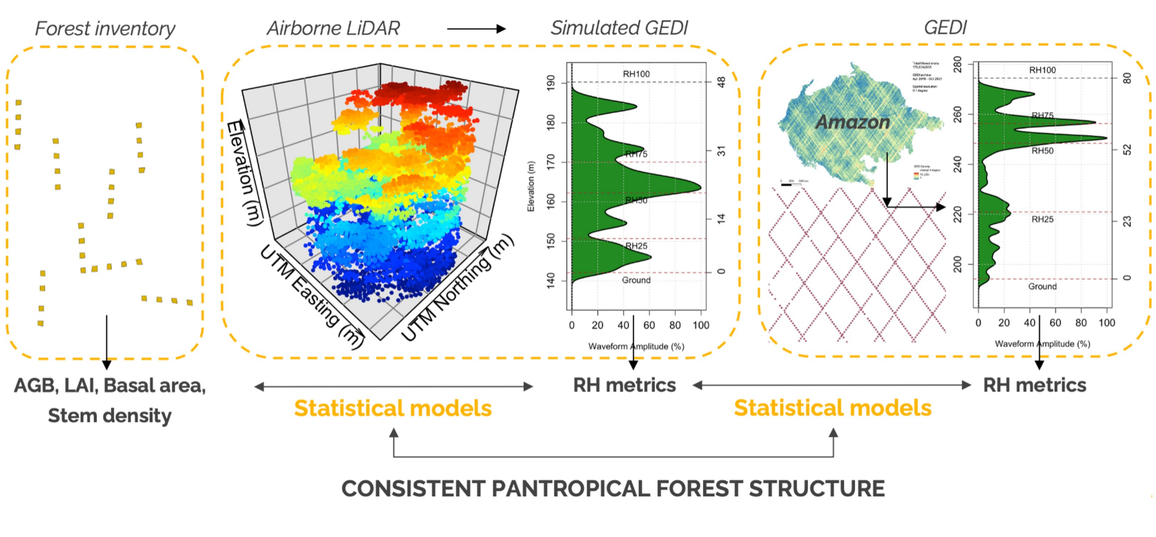

Figure 2. First, we relate forest properties from forest inventory plots and relative heights (RHs) from simulated GEDI metrics to airborne lidar overlapping the plots. Second, we used co-located GEDI-simulated shots from airborne lidar with spaceborne GEDI shots to build linear models between their corresponding RHs. Ultimately, we combined the two models.

RESULTS

Regional forest structure heterogeneity maps

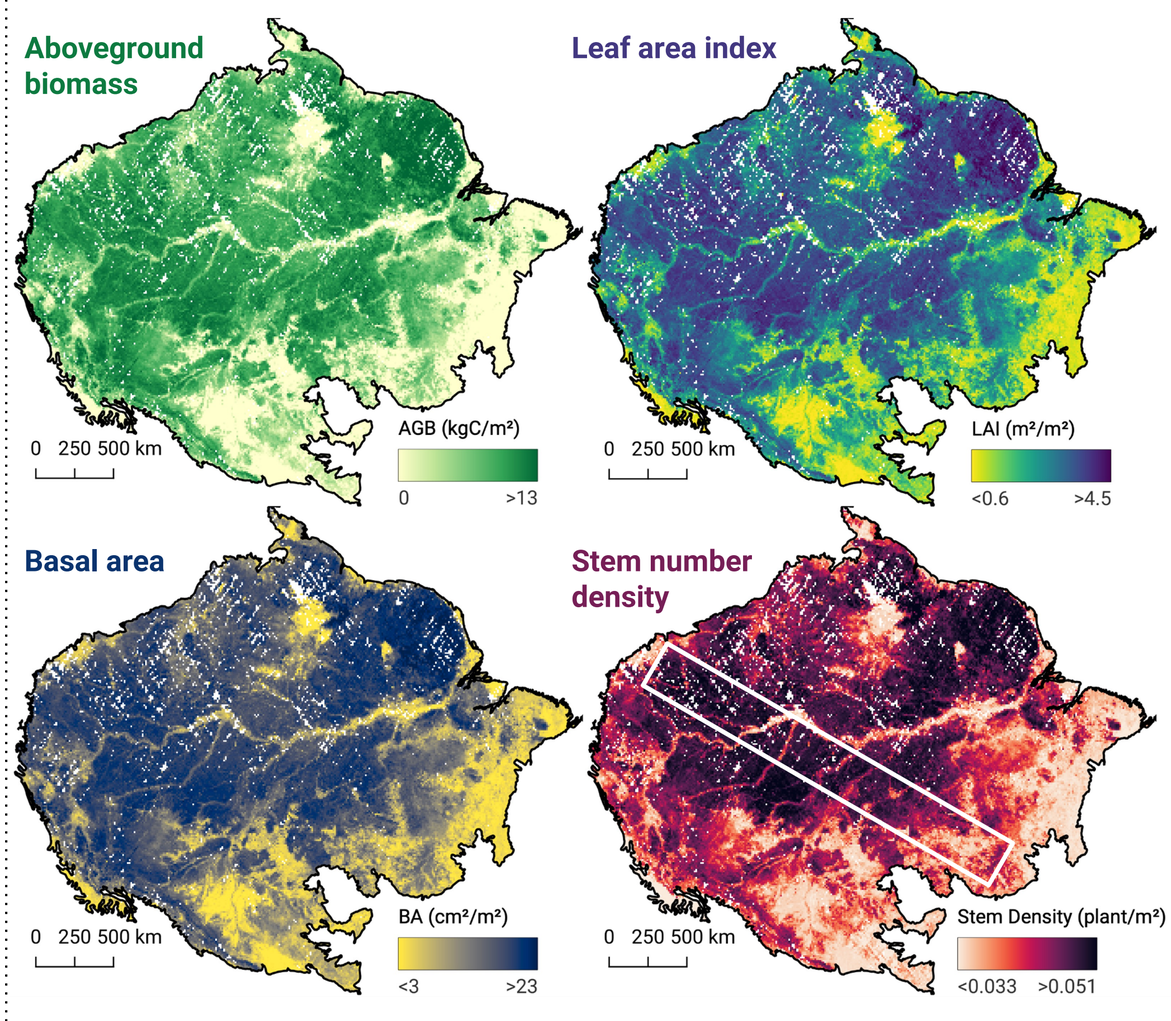

Figure 3. Preliminary results of Amazon wide forest structure obtained by Ordinary Least Squares regression aggregated at 0.1° spatial resolution. Only the trees with DBH ≥ 10 cm from forest inventory plots were used in building the regression models. The NW-SE transect (white) shown on the stem density map is used for Figure 4.

Climatic controls of forest structure

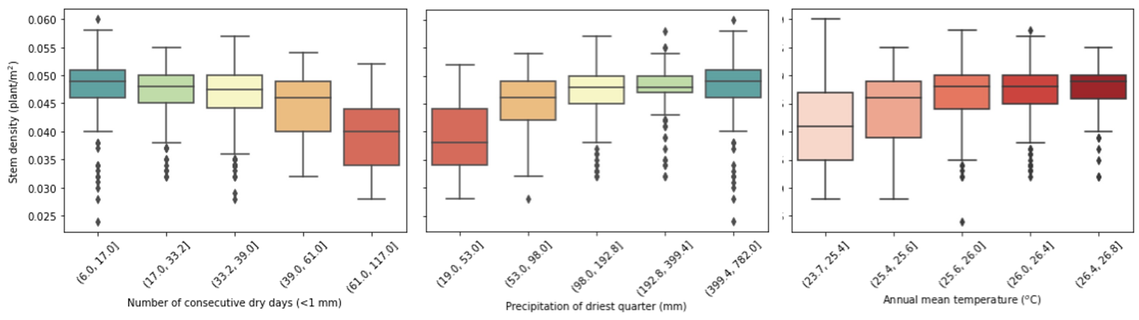

Figure 4. Relation of stem number density to the number of consecutive dry days (<1 mm), precipitation of driest quarter (mm) and annual mean temperature (°C) for a NW-SE transect over the Amazon biome (Figure 3).

SUMMARY and IMPORTANCE

Preliminary forest structure models show intriguing regional patterns and relations to environmental and climatic control factors.

These results fill a gap where systematic forest inventories are lacking and can be used to study a wide range of ecosystem processes and model predictions of forest carbon budget dynamics.

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Publications:

Csillik O., Keller M., Longo M., Bonal D., Burban B, Chave J., Coomes D.A., Derroire G, Feldpausch T.R, Görgens E.B., Jackson T., Ometto J.P., Villalba Valdivia M.I., Vincent G., (in prep), Amazon forest structural diversity estimated using field inventory plots, airborne lidar and GEDI spaceborne lidar

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