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## LiDAR and PALSAR-Derived Forest Aboveground Biomass, Paragominas, Para, Brazil, 2012

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Dataset Version: 1

### Summary

This dataset provides estimates of forest aboveground biomass for three study areas and the entire Paragominas municipality, in Para, Brazil, in 2012. Aboveground biomass (in megagrams of carbon per hectare) was measured for inventory plots within the study (focal) areas, and then assimilated and modeled with LiDAR and PALSAR metrics using gradient boosting machines (GBM) to predict spatially explicit forest aboveground biomass and uncertainties for the entire focal areas. The PALSAR data across the three focal areas was combined and used in a GBM model to predict forest aboveground biomass across the entire Paragominas municipality.

There are 7 data files in GeoTIFF (.tif) format, including estimated mean and standard deviation of forest aboveground biomass (Mg/ha) for three focal sites, and predicted forest aboveground biomass for the entire Paragominas municipality.

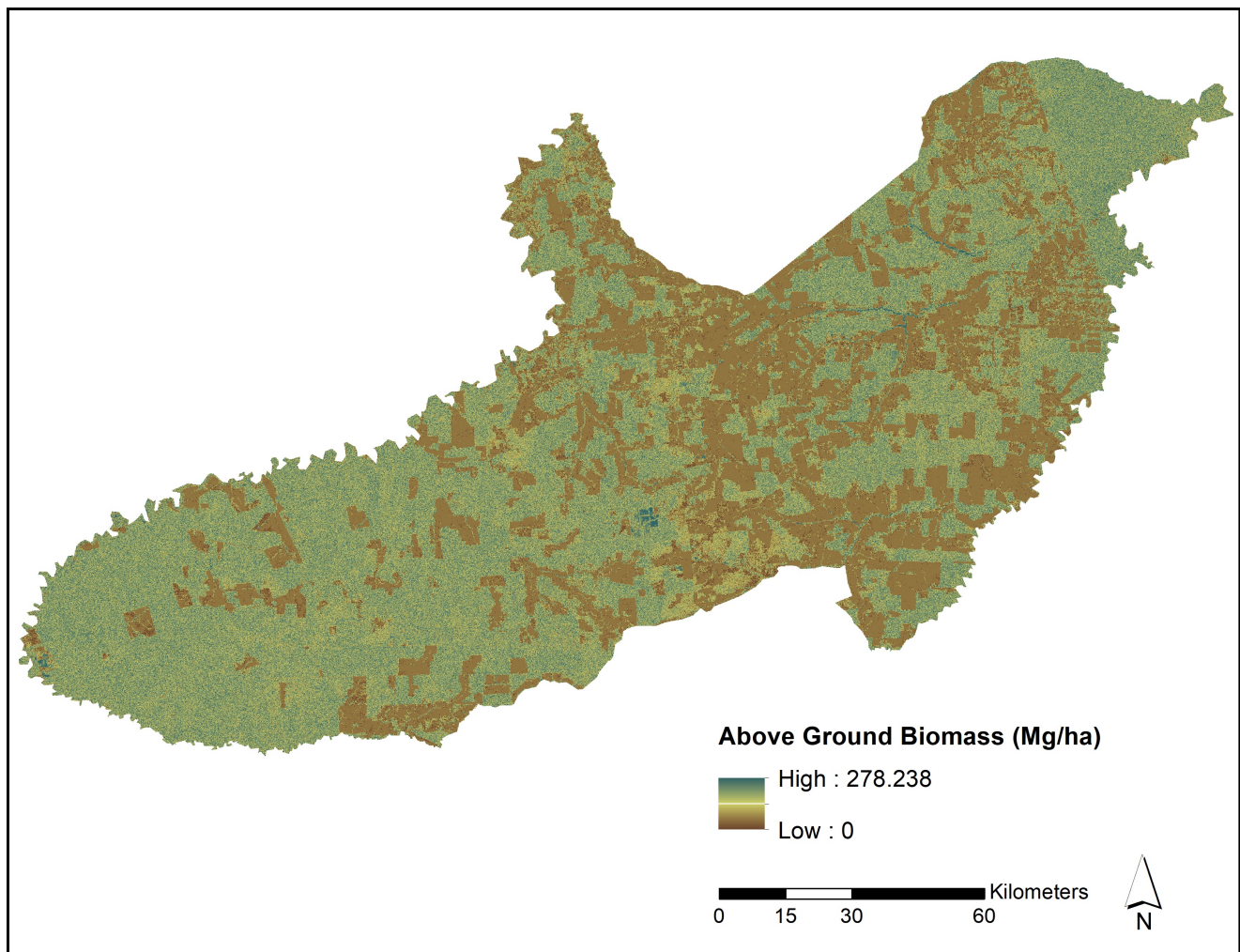


Figure 1. Assimilated predictions of forest aboveground biomass (megagrams of carbon per hectare) across the Paragominas Municipality, Brazil. (Source file: paragominas\_predicted\_agb.tif)

### Citation

Keller, M.M., P. Duffy, and W. Barnett. 2019. LiDAR and PALSAR-Derived Forest Aboveground Biomass, Paragominas, Para, Brazil, 2012. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1648>

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## 1. Dataset Overview

This dataset provides estimates of forest aboveground biomass for three study areas and the entire Paragominas municipality, in Para, Brazil, in 2012. Aboveground biomass (in megagrams of carbon per hectare) was measured for inventory plots within the study (focal) areas, and then assimilated and modeled with LiDAR and PALSAR metrics using gradient boosting machines (GBM) to predict spatially explicit forest aboveground biomass and uncertainties for the entire focal areas. The PALSAR data across the three focal areas was combined and used in a GBM model to predict forest aboveground biomass across the entire Paragominas municipality.

**Project:** [Carbon Monitoring System](#)

The NASA Carbon Monitoring System (CMS) is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. The System will use the full range of NASA satellite observations and modeling/analysis capabilities to establish the accuracy, quantitative uncertainties, and utility of products for supporting national and international policy, regulatory, and management activities. CMS will maintain a global emphasis while providing finer scale regional information, utilizing space-based and surface based data and will rapidly initiate generation and distribution of products both for user evaluation and to inform near-term policy development and planning.

### Related Datasets:

dos-Santos, M.N., and M.M. Keller. 2016. CMS: Forest Inventory and Biophysical Measurements, Para, Brazil, 2012-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1301>

dos-Santos, M.N., and M.M. Keller. 2016. CMS: LiDAR Data for Forested Areas in Paragominas, Para, Brazil, 2012-2014. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1302>

### Acknowledgments:

This work was funded by NASA CMS grant NNH13ZDA001N.

## 2. Data Characteristics

**Spatial Coverage:** Paragominas Municipality, Para, Brazil

**Spatial Resolution:** 50 m, 100 m

**Temporal Coverage:** 2012-01-01 to 2013-12-31

**Temporal Resolution:** one time estimate

**Study Area:** (all latitudes and longitudes given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Fazenda Andiroba (AND)	-46.84606389	-46.82801944	-2.531908333	-2.577147222
Fazenda Cauaxi (CAU)	-48.49631111	-48.46831389	-3.730113889	-3.767252778
Fazenda Nova Neonita (PAR)	-47.55837222	-47.51065	-3.306158333	-3.329777778
Paragominas, Brazil	-49.00363333	-45.99809722	-1.99755	-4.006052778

### Data File Information

There are 7 data files in GeoTIFF (.tif) format. Files are listed in the table below. Aboveground biomass data are provided in units of megagrams of carbon per hectare (Mg/ha)

File name	Number of files	Description
<i>site_predicted_agb_mean.tif</i>	3	Mean predicted aboveground biomass across each of three focal sites ('and', 'cau', or 'par') using LiDAR and PALSAR metrics
<i>site_predicted_agb_sd.tif</i>	3	Standard deviation of the predicted aboveground biomass across each of three focal sites ('and', 'cau', or 'par') using LiDAR and PALSAR metrics
<i>paragominas_predicted_agb.tif</i>	1	Predicted aboveground biomass across the entire Paragominas municipality using PALSAR focal site metrics

**Data File Properties:** The no data value for all files is -99999. There is one data band in each file.

File names	Projection	Grid size	Columns	Rows
<i>and_predicted_agb_mean.tif</i> & <i>and_predicted_agb_sd.tif</i>	WGS 84 UTM Zone 23S	100 meters	20	50
<i>cau_predicted_agb_mean.tif</i> & <i>cau_predicted_agb_sd.tif</i>	WGS 84 UTM Zone 22S	100 meters	31	41

par_predicted_agb_mean.tif & par_predicted_agb_sd.tif	WGS 84 UTM Zone 23S	100 meters	53	26
paragominas_predicted_agb.tif	WGS 84	0.000902292 degrees (50 m)	3331	2226

### 3. Application and Derivation

Brazilian tropical forests contain approximately one-third of the global carbon stock in aboveground tropical forest biomass. This dataset can be used to monitor carbon stock changes and associated uncertainties for the Paragominas municipality, a jurisdiction in the eastern Brazilian Amazon with a high proportion of logged and burned degraded forests.

### 4. Quality Assessment

The assimilated data products at each of the three focal sites received estimates of uncertainty using a Bayesian hierarchical model, but the estimates are not provided in this dataset.

### 5. Data Acquisition, Materials, and Methods

#### Focal Site Analysis

Field data were collected from inventory plots at each of three focal sites in the Paragominas municipality of Brazil. Aboveground biomass (in megagrams of carbon per hectare) was estimated from inventory plot tree species, tree basal area, tree diameter at breast height, etc. Some of these measurement data are available in a related dataset: <https://doi.org/10.3334/ORNLDAAAC/1301>.

The number of inventory plots for each focal site are:

Focal site	Plots	Size
AND	20	50 m x 50 m
CAU	88	20 m x 125 m
PAR	40	20 m x 125 m

Additional data for each focal site, including LiDAR data are available in a related dataset: <http://dx.doi.org/10.3334/ORNLDAAAC/1302>.

Since the inventory plot sizes varied from the LiDAR and PALSAR grid cells, inventory plot data were processed to be 2,500 m<sup>2</sup>. Processing began by calculating an area-weighted average of each LiDAR metric. For instance, if a 20 m x 125 m inventory plot overlapped with six 50 m x 50 m LiDAR cells, the average of a particular LiDAR metric was computed using the weights implied by the relative proportions of the six overlapping LiDAR cells. PALSAR polarizations were used to calculate 10th, 50th, and 90th percentiles inside each inventory plot polygon using the same routine.

The data from the inventory plots were aggregated from 50 m to 100 m resolution to mitigate computational convergence issues during the Bayesian analysis. The resultant data included the following information for each inventory plot:

- inventory plot identification number
- spatial polygon size
- inventory data (aboveground biomass estimate)
- LiDAR 10th, 50th, and 90th percentile metrics and skew metrics for return height
- PALSAR 10th, 50th, and 90th percentile metrics for HH and HV polarizations

For each focal site analysis, the inventory data were modeled using gradient boosting machines (GBM) and the LiDAR and PALSAR metrics (75% training data, 25% test data) to predict aboveground biomass across the focal areas. The predictions were assimilated with the GBM test data using the Wikle and Berliner (2007) Hierarchical Bayesian Modeling approach.

#### Paragominas Analysis

To estimate aboveground biomass across the entire Paragominas municipality, the PALSAR metrics were used as model predictors. PALSAR data were combined across the focal areas, and a predictive GBM model was developed (90% training data, 10% test data) using the 10th, 50th, and 90th percentiles of the HH and HV PALSAR metrics. The input data and resultant prediction map are at 50 m resolution. LiDAR data are typically very precise, but also expensive to collect. Radar data, such as PALSAR, are often cheaper and more widely available.

### 6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[LiDAR and PALSAR-Derived Forest Aboveground Biomass, Paragominas, Para, Brazil, 2012](#)

Contact for Data Center Access Information:

- E-mail: [uso@daac.ornl.gov](mailto:uso@daac.ornl.gov)
- Telephone: +1 (865) 241-3952

### 7. References

Wikle, C.K. and Berliner, L.M., 2007. A Bayesian tutorial for data assimilation. *Physica D: Nonlinear Phenomena*, 230(1-2), pp.1-16.

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