

LiDAR Surveys over Selected Forest Research Sites, Brazilian Amazon, 2008-2018

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Dataset Version: 1

Summary

This dataset provides the complete catalog of point cloud data collected during LiDAR surveys over selected forest research sites across the Amazon rainforest in Brazil between 2008 and 2018 for the Sustainable Landscapes Brazil Project. Flight lines were selected to overfly key field research sites in the Brazilian states of Acre, Amazonas, Bahia, Goias, Mato Grosso, Para, Rondonia, Santa Catarina, and Sao Paulo. The point clouds have been georeferenced, noise-filtered, and corrected for misalignment of overlapping flight lines. They are provided in 1 km² tiles. The data were collected to measure forest canopy structure across Amazonian landscapes to monitor the effects of selective logging on forest biomass and carbon balance, and forest recovery over time.

This dataset contains a total of 3,154 files: 3,152 files in compressed LAS (*.laz) file format, one file in comma separated values (*.csv) format, and one file in compressed Keyhole Markup Language (.kmz).

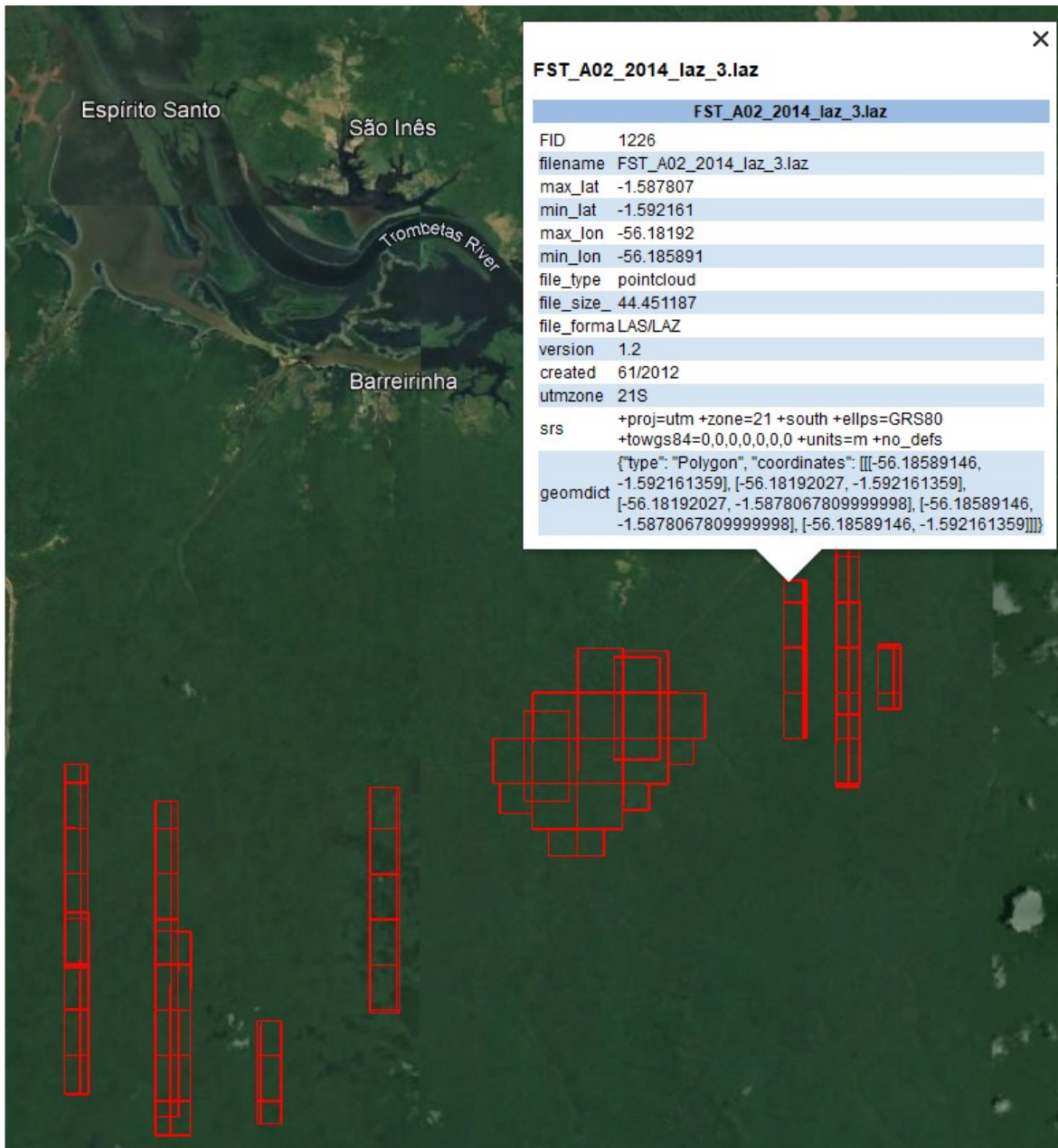


Figure 1. Bounding boxes for LiDAR tiles from surveys over western Para, Brazil are depicted in Google Earth from the KMZ file. Each feature in the KMZ provides key metadata about the corresponding tile. Source: cms_brazil_lidar_tile_inventory.kmz

Citation

dos-Santos, M.N., M.M. Keller, and D.C. Morton. 2019. LiDAR Surveys over Selected Forest Research Sites, Brazilian Amazon, 2008-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1644>

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1. Dataset Overview

This dataset provides the complete catalog of point cloud data collected during LiDAR surveys over selected forest research sites across the Amazon rainforest in Brazil between 2008 and 2018 for the Sustainable Landscapes Brazil Project. Flight lines were selected to overfly key field research sites in the Brazilian states of Acre, Amazonas, Bahia, Goias, Mato Grosso, Para, Rondonia, Santa Catarina, and Sao Paulo. The point clouds have been georeferenced, noise-filtered, and corrected for misalignment of overlapping flight lines. They are provided in 1 km² tiles. The data were collected to measure forest canopy structure across Amazonian landscapes to monitor the effects of selective logging on forest biomass and carbon balance, and forest recovery over time.

Project: Carbon Monitoring System (CMS)

The 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.

Related Publications:

Citations for the numerous related publications are given in the main reference section of this document, Section 7.

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>

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>

Acknowledgements:

LiDAR surveys performed through the Sustainable Landscapes project were commissioned by the United States Forest Service in collaboration with the Brazilian Enterprise for Agricultural Research (EMBRAPA) (<https://www.paisagenslidar.cnptia.embrapa.br>) and are archived through the Carbon Monitoring System project funded by NASA.

2. Data Characteristics

Spatial Coverage: Selected areas of the Amazon Basin and other regions in Brazil

Spatial Resolution: ~ 10 points per m² provided in 1 km² tiles over key field research sites

Temporal Coverage: June 2008 to August 2018

Temporal Resolution: single acquisition over most sites (multiple acquisition over some sites)

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
LiDAR flightlines over Brazil	-68.2897	-39.058	-1.5794	-26.6964

Data File Information

This dataset contains a total of 3,154 files: 3,152 files in compressed LAS (*.laz) file format, one file in comma separated values (*.csv) format, and one file in compressed Keyhole Markup Language (.kmz).

The LAS files hold LiDAR data (Table 1).

The files *cms_brazil_lidar_tile_inventory.csv* and *cms_brazil_lidar_tile_inventory.kmz* provide summaries of the LAS file contents in tabular form (.csv) and as viewable using Google Earth (.kmz) (Table 2). Both files provide similar information about the LiDAR inventory.

LAS File characteristics

File organization and naming convention: Files are organized according to the **Survey_reference_code** given in Table 1 below.

For example, the reference code **ANT_A01_2011_LiDAR** associates the *.las data files collected at the "Floresta Estadual do Antimary" research site in 2011 with the metadata **uuid** shown in Table 1.

Please refer to the Sustainable Landscapes metadata for the definitions of the 3-character site codes and additional site descriptions.

File names begin with their respective **Survey_reference_code** and end with a sequential number identifying the specific 1 km² tile data provided.

- ANT_A01_2011_laz_0.laz
- ANT_A01_2011_laz_1.laz
- ...
- ANT_A01_2011_laz_11.laz

Note: not all file names follow this structure. Please refer to specific survey reference code Sustainable Landscapes metadata for details about these alternatively-named files.

File format: The LAS standard is developed and maintained by the American Society for Photogrammetry and Remote Sensing (ASPRS; <https://www.asprs.org/divisions-committees/lidar-division/laser-las-file-format-exchange-activities>) and is currently on version 1.4. These data are distributed in LAS versions 1.0 through 1.2.

Table 1. LiDAR survey information. The *Survey_reference_code* associates the *.las data files collected at a research site in a given year. The WebGIS of the [Sustainable Landscapes Brazil](#) project provides capabilities for finding LiDAR and related field data.

State*	Survey_reference_code	UTM zone
AC	ANT_A01_2011_LiDAR	19S

State*	Survey_reference_code	UTM zone
AC	BON_A01_2013_LiDAR	19S
AC	HUM_A01_2013_LiDAR	19S
AC	RIB_A01_2014_LiDAR	19S
AC	TAL_A01_2013_LiDAR	19S
AM	BA3_A01_2014_LiDAR	20S
AM	BA3_A02_2014_LiDAR	20S
AM	BAR_A01_2014_LiDAR	20S
AM	DUC_A01_2012_LiDAR	21S
AM	DUC_A01_2017_LiDAR	20S
AM	ZF2_A01_2017_LiDAR	20S
AM	ZF2_A02_2017_LiDAR	20S
BA	CON_A01_2015_LiDAR	24S
GO	GO1_A01_2014_LiDAR	22S
MT	COT_A01_2011_LiDAR	21S
MT	FN1_A01_2013_LiDAR	22S
MT	FN1_A01_2016_LiDAR	21S
MT	FN2_A01_2013_LiDAR	21S
MT	FN2_A01_2016_LiDAR	21S
MT	FN3_A01_2014_LiDAR	21S
MT	FNA_A01_2013_LiDAR	21S
MT	FNB_A01_2014_LiDAR	21S
MT	FNC_A01_2017_LiDAR	21S
MT	FNC_A02_2017_LiDAR	21S
MT	FNC_A03_2017_LiDAR	21S
MT	FNC_A04_2017_LiDAR	21S
MT	FND_A01_2017_LiDAR	21S
MT	FND_A02_2017_LiDAR	21S
MT	FND_A03_2017_LiDAR	21S
MT	TAN_A01_2012_LiDAR	22S
MT	TAN_A01_2014_LiDAR	22S
MT	FN3_A01_2017_LiDAR	21S
PA	ANA_A01_2017_LiDAR	21S
PA	AND_A01_2013_LiDAR	23S
PA	AND_A01_2017_LiDAR	23S
PA	CAU_A01_2017_LiDAR	22S
PA	FST_A01_2013_LiDAR	21S
PA	PAR_A01_2017_LiDAR	23S
PA	PRG_A01_2017_LiDAR	23S
PA	SAN_A01_2014_LiDAR	21S

State*	Survey_reference_code	UTM zone
PA	SAN_A02_2014_LiDAR	21S
PA	SFX_A01_2012_LiDAR	22S
PA	SFX_A02_2012_LiDAR	22S
PA	ST1_A01_2013_LiDAR	21S
PA	ST1_A01_2016_LiDAR	21S
PA	ST2_A01_2013_LiDAR	21S
PA	ST2_A01_2016_LiDAR	21S
PA	ST3_A01_2014_LiDAR	21S
PA	ST3_A01_2017_LiDAR	21S
PA	TAC_A01_2013_LiDAR	22S
PA	TAP_A01_2012_LiDAR	21S
PA	TAP_A01_2017_LiDAR	21S
PA	TAP_A02_2012_LiDAR	21S
PA	TAP_A02_2013_LiDAR	21S
PA	TAP_A02_2016_LiDAR	21S
PA	TAP_A03_2012_LiDAR	21S
PA	TAP_A03_2013_LiDAR	21S
PA	TAP_A03_2016_LiDAR	21S
RO	JAM_A01_2011_LiDAR	20S
RO	JAM_A02_2011_LiDAR	20S
RO	JAM_A02_2013_LiDAR	20S
RO	JAM_A03_2013_LiDAR	20S
SC	CAG_A01_2013_LiDAR	22S
SC	MMA_A01_2017_LiDAR	22S
SP	CAN_A01_2014_LiDAR	23S
SP	CAN_A01_2017_LiDAR	23S
SP	CAN_A02_2014_LiDAR	23S
SP	CAN_A02_2017_LiDAR	23S
SP	SDM_A01_2012_LiDAR	23S
SP	SDM_A01_2017_LiDAR	23S

* **State codes** in the leftmost column refer to the Brazilian states of Acre (AC), Amazonas (AM), Bahia (BA), Goias (GO), Mato Grosso (MT), Para (PA), Rondonia (RO), Santa Catarina (SC), and Sao Paulo (SP).

Spatial Reference System (Well Known Text)

Note -- these data are located across six Universal Transverse Mercator (UTM) zones: 19S, 20S, 21S, 22S, 23S, and 24S. Please refer to Table 1 for the UTM zone for a respective survey reference code and file.

The OGC standard Well Known Text representation of the UTM system used for these data:

```

PROJCS["WGS 84 / UTM zone __S", ### Seven zones: 19, 20, 21, 22, 23, 24
GEOGCS["WGS 84",
DATUM["WGS_1984",
SPHEROID["WGS 84",6378137,298.257223563,
AUTHORITY["EPSG","7030"]],
AUTHORITY["EPSG","6326"]],
PRIMEM["Greenwich",0,
AUTHORITY["EPSG","8901"]],
UNIT["degree",0.01745329251994328,
AUTHORITY["EPSG","9122"]],
AUTHORITY["EPSG","4326"]],
UNIT["metre",1,
AUTHORITY["EPSG","9001"]],
PROJECTION["Transverse_Mercator"],
PARAMETER["latitude_of_origin",0],
PARAMETER["central_meridian",___], ### Varies by zone: -69, -63, -57, -51, -45, -39
PARAMETER["scale_factor",0.9996],
PARAMETER["false_easting",500000],
PARAMETER["false_northing",1000000],
AUTHORITY["EPSG","327__"], ### Varies by zone: 32719, 32720, 32721, 32722, 32723, 32724
AXIS["Easting",EAST],
AXIS["Northing",NORTH]]

```

Table 2. Variables in *cms_brazil_lidar_tile_inventory.csv* and *cms_brazil_lidar_tile_inventory.kmz*.

Field	Description
filename	filename
max_lat	maximum latitude extent (decimal degrees)
min_lat	minimum latitude extent (decimal degrees)
max_lon	maximum longitude extent (decimal degrees)
min_lon	minimum longitude extent (decimal degrees)
file_type	<i>always "pointcloud"</i>
file_size_mb	size of the file in megabytes
file_format	<i>always "LAS/LAZ"</i>
version	LAS specification version (<i>always from v1.0, v1.1, v1.2</i>)
created	file creation date
utmzone	UTM zone given as "###S" (<i>always from 19S, 20S, 21S, 22S, 23S, 24S</i>)
srs	proj4 string for the UTM zone

3. Application and Derivation

These LiDAR acquisitions are meant to measure forest canopy structure across Amazonian landscapes to monitor the effects of selective logging on forest biomass and carbon balance and forest recovery over time.

4. Quality Assessment

Checks for horizontal and vertical accuracy, and other standard quality control measures were performed by affiliated LiDAR survey vendors. Please refer to <http://mapas.cnpm.embrapa.br/paisagenssustentaveis/> for vendor information.

5. Data Acquisition, Materials, and Methods

Project Overview

Brazilian tropical forests contain approximately one-third of the global carbon stock in above-ground tropical forest biomass. Deforestation has cleared about 15% of the extensive forest on the Brazilian Amazon frontier. Logging, and understory forest fires may have degraded a similar area of forest. In response to the potential climatic effects of deforestation, policy makers have suggested reductions in emissions through deforestation and forest degradation and enhanced forest carbon stocks (REDD+). Carbon accounting for REDD+ requires knowledge of deforestation, degradation, and associated changes in forest carbon stocks.

Degradation is more difficult to detect than deforestation. This LiDAR inventory will continue to help researchers to quantify carbon stocks and changes and associated uncertainties in the Brazilian Amazon.

LiDAR Acquisition

LiDAR surveys were flown between June 2008 and August 2018. The data were collected and processed to point cloud files by commercial vendors under several grants, and incorporated into the broader integrated effort of the Sustainable Landscapes project. Sustainable Landscapes is supported by the United States Agency for International Development (USAID) and US Department of State. LiDAR surveys performed through the Sustainable Landscapes project were commissioned by the United States Forest Service in collaboration with the Brazilian Enterprise for Agricultural Research (EMBRAPA) and are archived through the Carbon Monitoring System project funded by NASA.

EMBRAPA maintains a metadata portal for the Sustainable Landscapes project at: <https://www.paisagenslidar.cnptia.embrapa.br/webgis/>.

6. Data Access

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

[LiDAR Surveys over Selected Forest Research Sites, Brazilian Amazon, 2008-2018](#)

Contact for Data Center Access Information:

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

7. References

Related Publications:

Andersen, Hans-Erik; McGaughey, Robert J.; Reutebuch, Stephen E. 2005. Estimating forest canopy fuel parameters using LIDAR data. *Remote Sensing of Environment*. 94: 441-449. <https://doi.org/10.1016/j.rse.2004.10.013>

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8. Dataset Revisions

Version	Release Date	Revision Notes
	2024-XX-XX	File names updated for ten files: TAP_A0*_2008*.laz. Fourteen duplicate data files were deleted. CSV and KMZ companion files were updated and moved to data files.
1.0	2019-12-31	Original release



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