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## LiDAR and DTM Data from Forested Land Near Manaus, Amazonas, Brazil, 2008

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### Summary

This data set provides LiDAR point clouds and digital terrain models (DTM) from surveys over the K34 tower site in the Cuieiras Biological Reserve, over forest inventory plots in the Adolpho Ducke Forest Reserve, and over sites of the Biological Dynamics of Forest Fragments Project (BDFFP) in Rio Preto da Eva municipality near Manaus, Amazonas, Brazil during June 2008. The surveys encompass the K34 eddy flux tower managed through the Large-scale Biosphere-Atmosphere Experiment in Amazonia, forest inventory plots managed by the Programa de Pesquisa em Biodiversidade (PPBio), and sites managed by the BDFFP. The LiDAR data was 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 data set contains 42 files: 28 data files in LiDAR (\*.laz) file format, 12 DTMs in GeoTIFF (\*.tif) format, along with one shapefile (\*.shp) and one file in compressed Keyhole Markup Language (KMZ) providing the LiDAR file footprints.



Figure 1. Footprints for surveyed areas in Amazonas, Brazil are included in amazonas\_lidar\_footprints.kmz. The K34 eddy flux tower (AmeriFlux BR-Ma2) is within the surveyed area at the Cuieiras Biological Reserve.

### Citation

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## 1. Dataset Overview

This data set provides LiDAR point clouds and digital terrain models (DTM) from surveys over the K34 tower site in the Cuieiras Biological Reserve, over forest inventory plots in the Adolpho Ducke Forest Reserve, and over sites of the Biological Dynamics of Forest Fragments Project (BDFFP) in Rio Preto da Eva municipality near Manaus, Amazonas, Brazil during June 2008. The surveys encompass the K34 eddy flux tower managed through the Large-scale Biosphere-Atmosphere Experiment in Amazonia, forest inventory plots managed by the Programa de Pesquisa em Biodiversidade (PPBio), and sites managed by the BDFFP. The LiDAR data was 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.

### Related Data Sets:

Miller, J.B., L.V. Gatti, M.T.S. D'Amelio, A. Crotwell, E. Dlugokencky, P.S. Bakwin, P.E. Artaxo, and P. Tans. 2013. LBA-ECO TG-06 Vertical Profiles of Atmospheric Trace Gases over the Amazon Basin. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1175>

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>

Martin, S.T., P.E. Artaxo, Q. Chen, A.B. Guenther, S.S. Gunthe, J.L. Jimenez, A. Manzi, K.L. Prenni, U. Poschl, J. Schneider, and E. Swietlicki. 2016. AMAZE-08 Aerosol Characterization and Meteorological Data, Central Amazon Basin: 2008. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1308>

Lefsky, M.A., S.R. Saleska, and Y.E. Shimabukuro. 2017. LiDAR and DTM Data from Tapajos National Forest in Para, Brazil 2008. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1514>

### Acknowledgements:

The survey campaigns were funded through grants from NASA (#NNX09AI33G; M. Lefsky et al.) and the NSF (#0721140; S. Saleska, G.G. Parker, Y. Shimabukuro et al.). Additional funding was provided by the Smithsonian Tropical Research Institute for the surveys of Rio Preto da Eva.

## 2. Data Characteristics

**Spatial Coverage:** LiDAR surveys over forest reserves and municipalities north of Manaus in Amazonas, Brazil

**Spatial Resolution:** LiDAR: ~10 points per m<sup>2</sup>; DTMs: 1 m

**Temporal Coverage:** 2008-06-07 to 2008-06-24

**Temporal Resolution:** One-time flights

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Forest reserves and municipalities north of Manaus in Amazonas, Brazil	-60.215	-59.764	-2.32	-2.98

### Data File Information

This data set contains 42 files: 28 data files in LiDAR (\*.laz) file format, 12 DTMs in GeoTIFF (\*.tif) format, along with one shapefile in a zip archive (\*.zip) and one file in compressed Keyhole Markup Language (.kmz) providing the LiDAR file footprints.

There are 28 LiDAR point cloud (\*.laz) files and 12 digital terrain models (DTM; \*.tif) included in this data set.

The survey footprints are provided as a shapefile (4 files in *amazonas\_lidar\_footprints.zip*) with the footprint of each LAZ file as a feature record identified by the "FILE" attribute. The spatial reference properties for the data files are listed below and additional metadata for each of the survey areas is provided in Table 1.

The shapefile is also provided as a companion file in KMZ (\*.kmz) format for viewing in Google Earth.

Data files are named according to the survey area.

Filename	Survey Area
<i>CUI_*</i>	Cuieiras Forest Reserve, Amazonas, Brazil
<i>DUC_*</i>	Adolphos Ducke Forest Reserve, Amazonas, Brazil
<i>PRE_*</i>	Rio Preto da Eva Municipality, Amazonas, Brazil

### Spatial Reference Properties

WGS\_1984\_UTM\_Zone\_20S, EPSG 32720

Projection: Transverse\_Mercator

false\_easting: 500000.0

false\_northing: 10000000.0

central\_meridian: -63.0  
scale\_factor: 0.9996  
latitude\_of\_origin: 0.0  
Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS\_WGS\_1984  
Angular Unit: Degree (0.0174532925199433)  
Prime Meridian: Greenwich (0.0)  
Datum: D\_WGS\_1984  
Spheroid: WGS\_1984  
Semimajor Axis: 6378137.0  
Semiminor Axis: 6356752.314245179  
Inverse Flattening: 298.257223563

**Table 1.** Metadata for LiDAR survey areas

Survey Area	Date(s)	Number of tiles	Total area (ha)	Avg. point density (ppm <sup>2</sup> )	Avg. first return density (ppm <sup>2</sup> )	Avg. flight altitude (m)
CUI_A01	2008-06-09, 2008-06-22	4	545.77	12.21	9.51	833
DUC_A01	2008-06-08, 2008-06-09, 2008-06-22, 2008-06-24	14	1199.95	55.46	42.76	816
PRE_A01	2008-06-22	2	409	12.09	9.3	723
PRE_A02	2008-06-10	1	41.9	11.02	8.5	777
PRE_A04	2008-06-07	2	242.32	13.10	10.21	880
PRE_A05	2008-06-07	1	138.41	12.03	9.06	879
PRE_A06	2008-06-10	1	124.02	12.99	10.08	812
PRE_A07	2008-06-10	3	8.85	15.08	11.76	881

### 3. Application and Derivation

The LiDAR data was 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 (Stark et al., 2012).

### 4. Quality Assessment

Checks for horizontal and vertical accuracy, and other standard quality control measures were performed by dataset vendors. Refer to <http://mapas.cnpm.embrapa.br/paisagens sustentaveis/> for vendor information.

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

#### Sites

The Cuieiras Biological Reserve and Adolpho Ducke Forest Reserve are located near Manaus in Amazonas, Brazil and are part of the Long Term Ecological Research Network. The survey areas within Adolpho Ducke Forest Reserve encompass long-term monitoring plots managed by the Brazilian PPBio Project (de Castilho et al., 2006) and sits at the intersection of two major drainage areas, the Amazon River and the Rio Negro. The survey areas within Cuieiras Biological Reserve encompass the K34 eddy flux tower and forest inventory plots managed through the LBA project (Araújo, 2002). The K34 tower is deployed in a medium elevation plateau with primary forest cover about 60 km north of Manaus. The K34 tower has been in continuous operation since 1999. Please visit the Ameriflux website for additional information and access to the eddy flux tower data (<http://ameriflux.lbl.gov/>).

Rio Preto da Eva is a municipality located east of Manaus in Amazonas, Brazil encompassing most of the study area for the Biological Dynamics of Forest Fragments project. The project was established in 1985 to monitor the dynamics of forested land in different states of fragmentation and recovery from logging (Bierregaard, et al., 1992).

The surveyed areas average 2145 mm of precipitation annually with temperatures ranging from 24 to 33 °C and averaging 27.4 °C. The Brazilian state of Amazonas is covered almost entirely by Amazon rainforest and is the most species-rich tract of tropical rainforest in the world.

#### Data Acquisition

LiDAR surveys were flown over the survey sites in June 2008 with a Leica ALS-50 instrument LiDAR (Heerbrugg, Switzerland), funded by grants from NASA (#NNX09AI33G to M. Lefsky et al.) and NSF (#0721140 to S. Saleska, G.G. Parker, Y. Shimabukuro et al.). The data were collected and processed to point cloud and DTM files by commercial vendors under these 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).

### 6. Data Access

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

[LiDAR and DTM Data from Forested Land Near Manaus, Amazonas, Brazil, 2008](#)

Contact for Data Center Access Information:

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

## 7. References

Araújo, A.C., 2002. Comparative measurements of carbon dioxide fluxes from two nearby towers in a central Amazonian rainforest: The Manaus LBA site. *J. Geophys. Res.* 107. <https://doi.org/10.1029/2001JD000676>

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Stark, S.C., B.J. Enquist, S.R. Saleska, V. Leitold, J. Schiatti, M. Longo, L.F. Alves, P.B. Camargo, and R.C. Oliveira. 2015. Linking canopy leaf area and light environments with tree size distributions to explain Amazon forest demography. *Ecology Letters*. <https://doi.org/10.1111/ele.12440>

## 8. Dataset Revisions

Version	Release Date	Revision Notes
	2024-XX-XX	DUC_*.laz files renamed to conform to file naming convention. The LiDAR footprint files (*.zip, *.kmz) were regenerated to fix unclosed polygons. The KMZ file was moved from companion files to data files.
1.0	2017-08-15	Original release



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