AfriSAR: Mondah Forest Tree Species, Biophysical, and Biomass Data, Gabon, 2016

Documentation Revision Date: 2018-10-29

Data Set Version: 1

Summary

This dataset provides plot-level estimates of basal area, aboveground biomass, number of trees, maximum tree height, and basal-area-weighted wood specific gravity that were derived from observations of nearly 6,700 individual trees including tree family, species, DBH, the height of each tree, and their x, y location within 25 x 25 m subplots. These field data were collected from 15 1-hectare plots located across the Mondah Forest of Gabon as part of the AfriSAR Campaign in 2016. These biophysical and biomass data were used for training models to derive the AfriSAR remote sensing-based aboveground biomass products.

There are five *.csv files provided with this dataset.

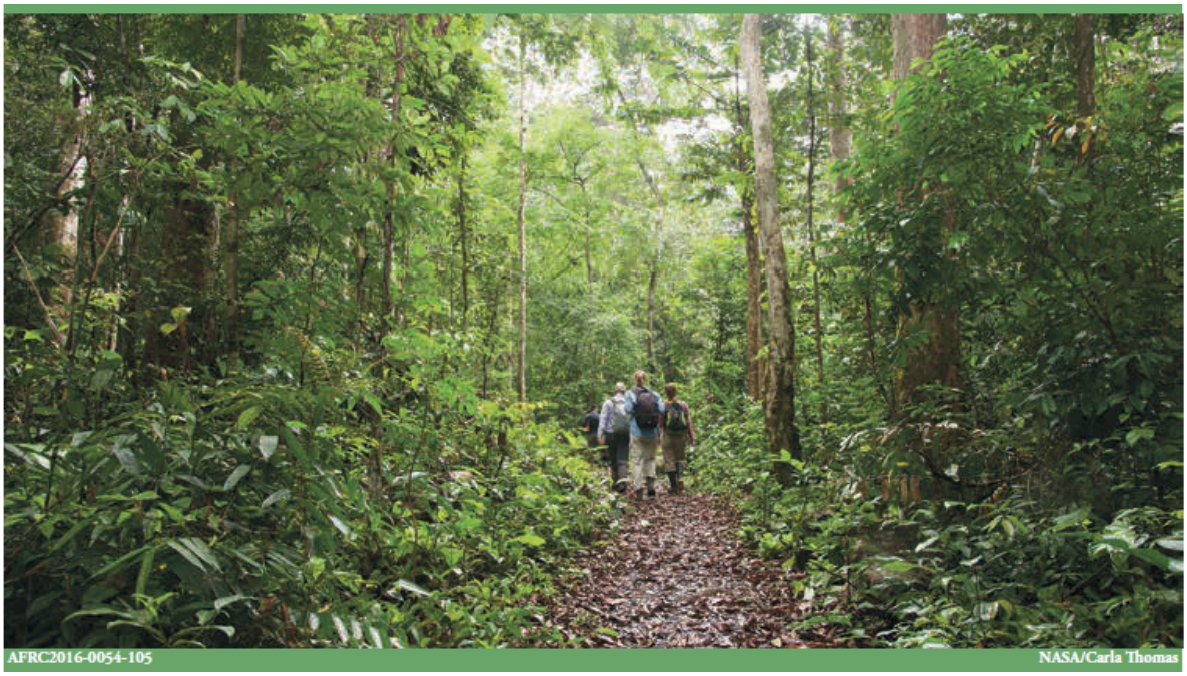

Figure 1: Collecting field data in Mondah Forest, Gabon. Credit: Carla Thomas/NASA (2016).

Citation

Fatoyinbo, T., S.S. Saatchi, J. Armston, J. Poulsen, S. Marselis, N. Pinto, L. Duncanson, L.J.T. White, and K. Jeffery. 2018. AfriSAR: Mondah Forest Tree Species, Biophysical, and Biomass Data, Gabon, 2016. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1580

Table of Contents

1. Data Set Overview
2. Data Characteristics
3. Application and Derivation
4. Quality Assessment
5. Data Acquisition, Materials, and Methods
6. References

1. Data Set Overview

This dataset provides (1) plot-level estimates of basal area, aboveground biomass, number of trees, maximum tree height, and basal-area-weighted wood specific gravity that were derived from (2) observations of nearly 6,700 individual trees including tree family, species, DBH, the height of each tree, and their x,y location within 25 x 25 m subplots. These field data were collected from 15 1-hectare plots located across the Mondah Forest of Gabon as part of the AfriSAR Campaign in 2016. These biophysical and biomass data were used for training the above ground biomass prediction models for the AfriSAR LVIS remote sensing above ground biomass density products.

Project: **AfriSAR**

The AfriSAR mission was an airborne campaign that collected radar and field measurements of tropical forests in Gabon, West Africa. The mission was a NASA collaboration with the European Space Agency (ESA) and the Gabonese Space Agency. During the 2016 AfriSAR campaign, NASA UAVSAR and LVIS instruments collected data that will be used to derive forest canopy height, structure, and topography. The AfriSAR data is a precursor to upcoming spaceborne missions that examine the role of forests in Earth's carbon cycle.

Acknowledgements:

Thanks to Christelle Tayo, Vincent Medjibe and the Agence Nationale des Parcs Nationaux in Gabon (ANPN) National Resource Inventory Team for helping with the collection of the field data. Thanks to ANPN for helping with field permitting and research in the country. Many thanks to Nicolas Labriere, Victoria Meyer and the ForestPlots Team for helping with species ID and dataset cleanup. This data collection was funded through the NASA AfriSAR project.

2. Data Characteristics

Spatial Coverage: Mondah Forest, Gabon

Spatial Resolution: 0.0625 - 1.0 ha plots

Temporal Coverage: 2016-03-01 to 2016-03-23

Temporal Resolution: One-time measurements

Study Area (coordinates in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Mondah Forest, Gabon	9.316216	9.422509	0.616939	0.538705

Data File Information

There are five *.csv files provided with this dataset. Note that the three plot-level files have the same structure.

Data File	Description
Mondah_Field_Data_Trees.csv	Individual tree observations were collected at the 25 m x 25 m, or 0.0625 ha subplot level.
Mondah_Field_Data_Plot-0_0625ha.csv	Vegetation characteristics and estimates of biomass at 25 m x 25 m, or 0.0625 ha plot-level
Mondah_Field_Data_Plot-0_25ha.csv	Vegetation characteristics and estimates of biomass aggregated to 50 m x 50 m, or 0.25 ha plot-level
Mondah_Field_Data_Plot-1ha.csv	Vegetation characteristics and estimates of biomass aggregated to 100 m x 100 m, or 1 ha plot-level
Mondah_Field_Data_OrigCoords.csv	The original field Global Positioning System (GPS) coordinates of each plot are also provided at the 0.0625 ha subplot level (GPS Coordinates).

Missing values for field data:

A value of -9999 means invalid data for numeric fields. For character fields the code for invalid data is “NA”. Zero, "0", is always a valid value.

Data Dictionary

Table 1. The tree data file (*_Tree) contains the following columns with accompanying information.

Column Name	Variable Type	Units/format	Description
plot	chr		name of the plot in which tree is located
subplot	num		number of the subplot in which the tree is located, assuming subplots of 25x25 m
tree_date	date	yyyy-mm-dd	date when the tree was measured
family	chr		taxonomic family to which the tree belongs
species	chr		tree species name

Column Name	Variable Type	Units/format	Description
wsg	num	g/cm3	wood specific gravity, derived with the BIOMASS package in R, based on the species, genus and/or family of the tree
tree	num		tag of the tree in the field
stem	num		number of the stem, if tree splits below breast height (1.3 m) the tree is considered to have multiple stems indicated in this column with a number
epsg	num		epsg code of the projection in which the x and y coordinate are expressed
x	num	m	the x coordinate of the tree location. Easting coordinate in the map projection (see epsg field)
y	num	m	the y coordinate of the tree location. Northing coordinate in the map projection (see epsg field)
status	num		tree status alive (1) or dead (0)
allom_key	num		indication of the allometry used to estimate biomass. 1 = use of pan-tropical allometric equation from Chave et al. 2014 if height measurement is absent, 2 = use of the pantropical allometric equation published in Chave et al. 2014 with real or modeled height.
a_stem	num	m2	area of the stem at breast height, calculated from d.stem
h_t	num	m	measured height of the tree
h_t_mod	num	m	tree heights modelled using local or regional DBH-Ht relationship
d_stem	num	m	diameter of stem at measurement height
d_stem.valid	num		valid (1) or invalid (0) tree measurement
d_ht	num	m	height at which the stem diameter was measured
m_agb	num		mass of above-ground components of tree (kg) estimated with Chave et al. 2014 allometric equation

Table 2. Each of the three plot-level data files (*_Plot-1ha, *_Plot-0.25ha, and *_Plot-0.0625ha) contain the following columns.

Column Name	Variable Type	Units/format	Description
plot	chr		name of the plot
subplot	num		number of the subplot, provides unique identifier together with the plot name
date	date	yyyy-mm-dd	date when the plot data was collected
vegetation	chr		type of vegetation (TropRF = Tropical Rain Forest)
map	num		mean annual precipitation (mm), derived from worldclim global climate data (worldclim.org) database
mat	num		mean annual temperature (Celsius), derived from worldclim global climatedata (worldclim.org) database
pft_name	chr		name of the plant functional type this vegetation is part of
latitude	num		latitude of location where sampled (-90 to 90 deg South to North)
longitude	num		longitude of location where sampled (-180 to 180 West to East)
p_origin	chr		origin of the plot for which longitude/latitude are provided, C=center
p_orientation	num	degrees	orientation of the plot in degrees clockwise from UTM map grid north
p_shape	chr		shape of the plot (R=rectangular)

Column Name	Variable Type	Units/format	Description
p_majoraxis	num	m	length of the longest axis of the plot
p_minoraxis	num	m	length of the minor axis of the plot
p_geom	chr		wkt containing geometry of the plot
p_epsg	num		epsg indicating the projection of the plot geometry
p_area	num	m2	area of the plot
p_mindiam	num		minimum diameter of trees measured in the field
sp_ix	num		subplot column index. Each plot is divided into a number of columns and rows using the subplot information, the number being dependent on the spatial resolution of the output biomass values. Sp.ix are the column numbers, left to right. See Figure 2.
sp_iy	num		subplot row index. Each plot is divided into a number of columns and rows using the subplot information, the number being dependent on the spatial resolution of the output biomass values. Sp.iy are the row number, top to bottom. See Figure 2.
dft	chr		dominant plant functional type: EA = evergreen angiosperm, DG = deciduous gymnosperm
agb	num	kg	total above ground biomass in this plot
agb_valid	num		valid (1) or invalid (0) agb value
agb_lower	num	kg	lower limit of standard error of mass of above-ground standing trees and shrubs
agb_upper	num	kg	upper limit of standard error of mass of above-ground standing trees and shrubs
agbd_ha	num	Mg/ha	mass density of above-ground standing trees and shrubs
agbd_ha_lower	num	Mg/ha	lower limit of standard error of mass density of above-ground standing trees and shrubs
agbd_ha_upper	num	Mg/ha	upper limit of standard error of mass density of above-ground standing trees and shrubs
sn	num		number of stems in plot
snd_ha	num		plot stem number density
sba	num	m2	plot stand basal area
sba_ha	num	m2/ha	stand basal area per ha based on sba and plot size
swsg_ba	num	g/cm3/m2	basal-area-weighted wood specific gravity
h_t_max	num	m	maximum total height of plants from ground to highest leaf

Table 3. The data file with the original plot coordinates (*_OrigCoords) is organized as follows. See processing description below and note about limited usability.

Column Name	Variable Type	Units/format	Description
Date	date		date when plot coordinates were collected
Name	chr		plot name
Altitude	chr	m	plot altitude, measured by GPS
Coordinate	chr		coordinate identifier of the plot
Latitude	chr		latitude coordinate expressed in degree, minute, second (e.g. 00,35076° = 00° 35' 07.6)

Column Name	Variable Type	Units/format	Description
Longitude	chr		Longitude coordinate expressed in degree, minute, second (e.g. 09,20264° = 09° 20' 26.4)
Precision	num	m	GPS coordinate precision

3. Application and Derivation

These data were used for training the above ground biomass prediction models for the AfriSAR LVIS above ground biomass density product.

4. Quality Assessment

For each plot level aboveground biomass value we calculated the upper and lower limits of standard error of mass of above-ground standing trees and shrubs. These estimates are included in the data files.

5. Data Acquisition, Materials, and Methods

These field data were collected from 15 1-hectare plots located across the Mondah Forest of Gabon as part of the AfriSAR Campaign in 2016 (Figure 2). These biophysical and biomass data will be used for training the above ground biomass prediction models for the AfriSAR LVIS remote sensing above ground biomass density products.

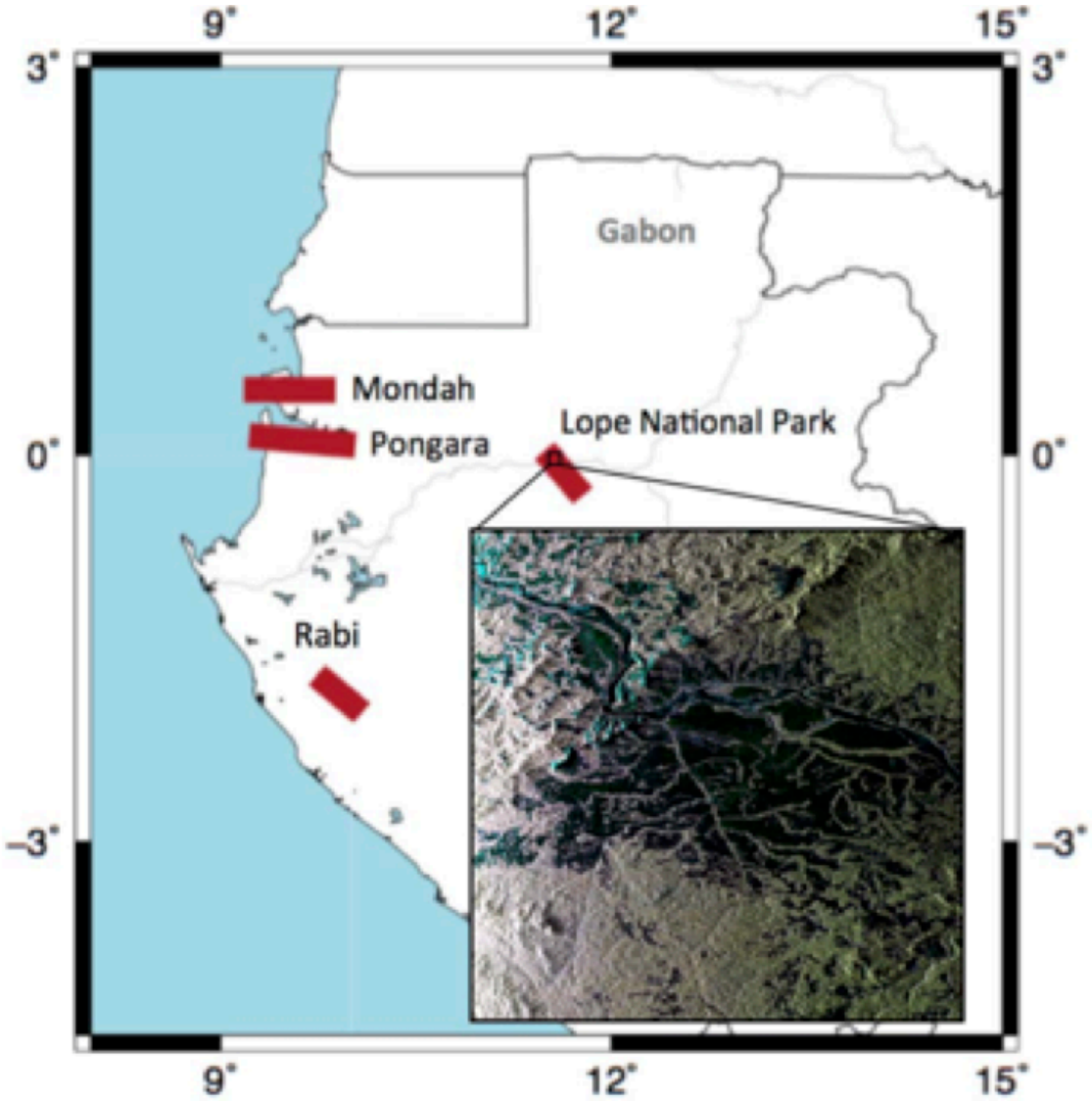

Figure 2. Showing the sampling locations in the coastal Mondah Forest of Gabon (Lavelle et al. 2017)

Individual trees were observed in 0.0625 ha subplots and plot-level data estimates were aggregated at 0.0625, 0.25, and 1 ha spatial resolutions. See Figure 3.

Individual Tree Measurements

For each 0.0625 ha subplot the data covers: GPS location of the 4 corners, x,y location of trees within a subplot, measurements of live tree family, species, DBH, height of each tree, and biomass at individual tree and plot level. Data file: Mondah_Field_Data_Trees.csv. Family and species of each tree was determined by a local botanist. DBH is the Diameter at Breast Height measured with a diameter measurement tape at 1.3 m height. Tree height measured in the field with DBH meter and a clinometer. Biomass of each tree is estimated using the Chave et al. 2014 equation with tree diameter, wood specific gravity (defined by tree species) and tree height. From the biomass of each individual tree, the biomass at plot level was calculated by adding the biomass of every tree within the 1 ha plot boundaries**.**

Aggregated Plot-level Estimates

At each plot level we calculated basal area, aboveground biomass, number of trees per plot, maximum tree height, and basal-area-weighted wood specific gravity. Respective aggregated data files: Mondah_Field_Data_Plot-0.0625ha.csv, Mondah_Field_Data_Plot-0.25ha.csv, and Mondah_Field_Data_Plot-1ha.csv. Biomass density information for different plot sizes was calculated by adding the biomass data for each individual tree within the boundaries of a certain subplot and divide by the area of that subplot to calculate biomass density for each subplot.

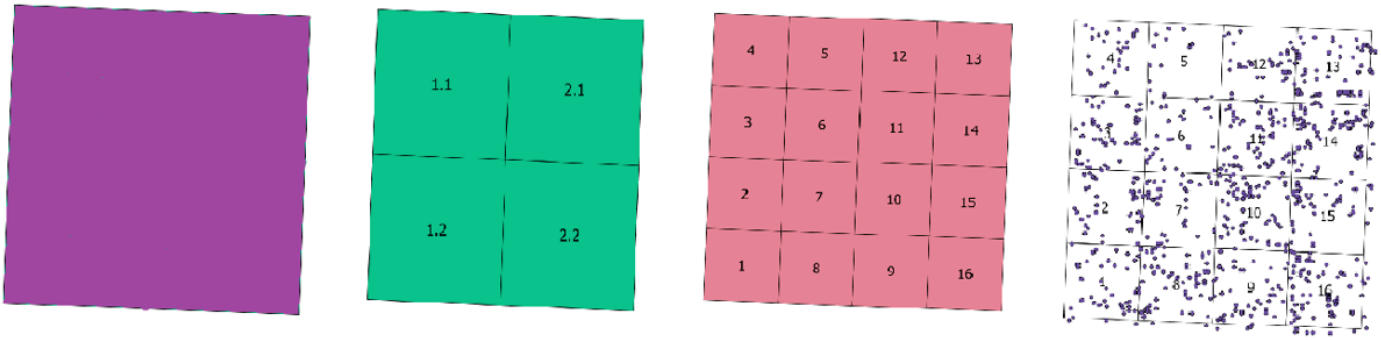

Figure 3. Spatial arrangement of subplots (from left to right) for 1 ha (Plot-1ha), 0.25 ha (Plot-0.25ha), and 0.0625 ha (Plot-0.0625ha) spatial resolutions. The reconstructed stem map is shown on the right.

Original GPS Coordinates

The original field Global Positioning System (GPS) coordinates of each plot are also provided at the 0.0625 ha subplot level (Mondah_Field_Data_OrigCoords.csv). Note that geolocation errors from the GPS measurements caused the measured points to not create perfect squares. These points have been adjusted to create the weighted best plot locations which are provided in the three plot-level measurement files. These original coordinates are not provided in decimal degrees to clearly denote their limited usefulness. They are included only for completeness of the data collection record. Plot altitude (elevation) maybe useful.

6. References

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