CMS: Mangrove Canopy Characteristics and Land Cover Change, Tanzania, 1990-2014

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Data Set Version: V1

Summary

This data set provides canopy height, land cover change, and stand age estimates for mangrove forests in the Rufiji River Delta in Tanzania. The estimates were derived from a canopy height model (CHM) using TanDEM-X imagery and Polarimetric SAR interferometry (Pol-InSAR) techniques. Landsat imagery circa 1990 and circa 2014 was used to estimate stand age between 1994 and 2014 and for forest land cover change modeling.

There are three GeoTIFF files (.tif) with this data set.

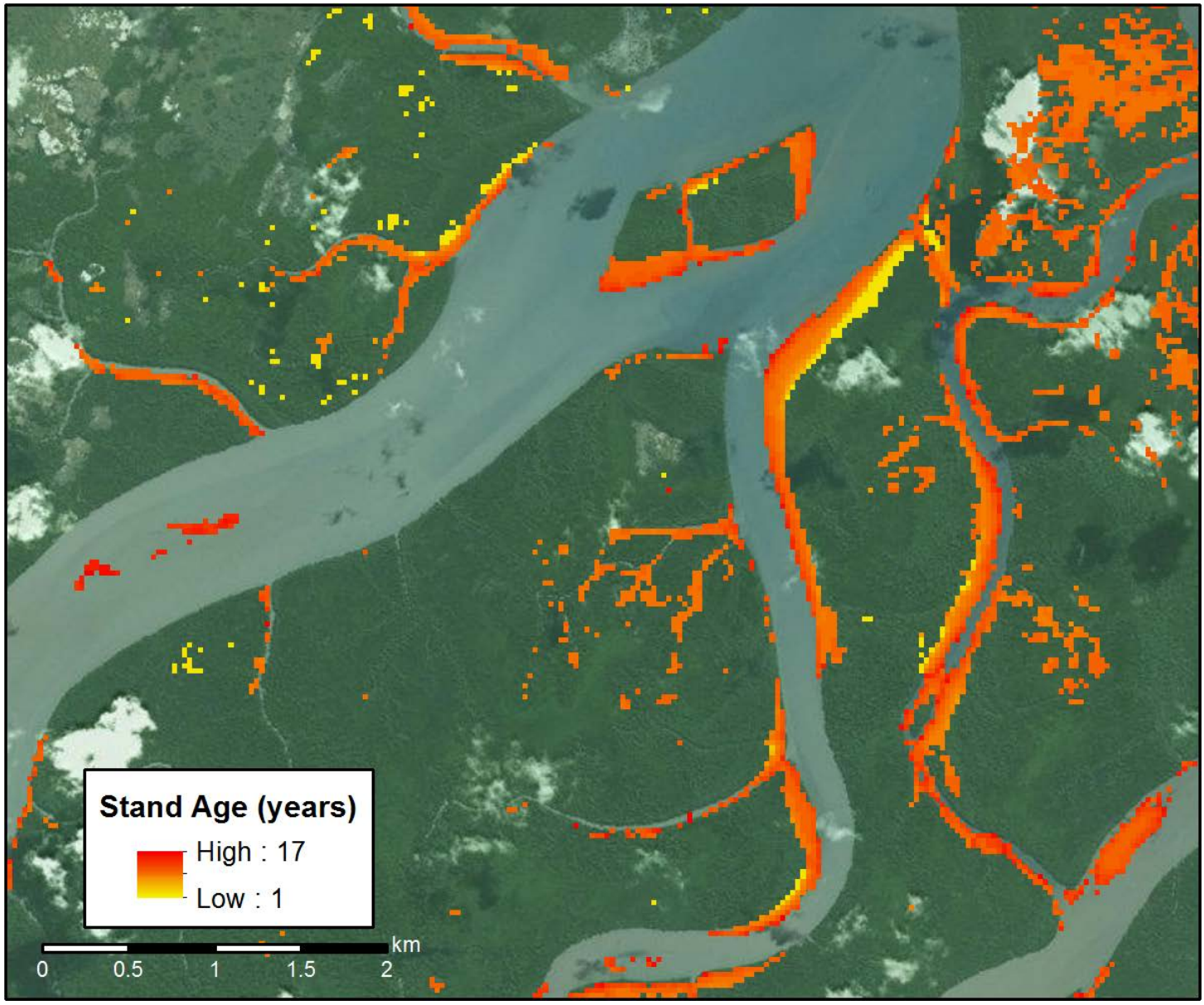

Figure 1. Mangrove forest stand age since 1994 for the Rufiji River Delta study site. Derived from Landsat imagery at 30-m resolution.

Citation

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1. Data Set Overview

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Project: Carbon Monitoring System (CMS)

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.

2. Data Characteristics

Spatial Coverage: Tanzania

Spatial Resolution: Canopy height (12-m x 12-m), Land cover change (30-m x 30-m), stand age (30-m x 30-m)

Temporal Coverage: Data covers the period 1990-01-01 to 2014-12-31

Temporal Resolution: One time estimate

Study Area (All latitudes and longitudes are given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
East Africa, Tanzania	39.192352	39.497222	-7.50833	-8.035212

Feedback

Data Description

Data Files

There are three GeoTIFF (.tif) data files with this data set.

Table 1. Data file descriptions.

File name	Description
Rufiji_Stand_Age.tif	Stand ages derived from modeling and Landsat imagery
Rufiji_Land_Cover_Change.tif	Land cover change derived from modeling and Landsat imagery
Rufiji_TDX_CHM.tif	Canopy height derived from TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurements).

GEoTIFF File Properties

Table 2. Properties common to all files.

Datum	File type	Map units	Fill value	# Bands
WGS84	raster	degree	0	1

Table 3. Properties of individual files.

Data File	min_lon	min_lat	max_lon	max_lat	# Columns	# Rows	Pixels, units, min-max values	Data type
Rufiji_Stand_Age.tif	39.20333	-7.948888	39.474444	-7.711666	992	829	stand age, years, 1-17	byte
Rufiji_Land_Cover_Change.tif	39	-8	39.50833	-7.50833	2000	2000	mangrove area, categorical, 1-3	byte
Rufiji_TDX_CHM.tif	39	-8	39.50833	-7.50833	4501	4501	canopy height, meters, 1-46	float

3. Application and Derivation

Mangroves may only represent 3% of the global forest cover, but it has been estimated that at the current rates of degradation, these forests can release

up to 10% of the total carbon emissions from deforestation worldwide (Donato et al., 2011). The large carbon stocks along with the many economical ecosystem services, high rates of degradation, and threats from rising seas, make mangrove environments important regions of interest for climate mitigation and adaptation plans (Alongi et al., 2002). Remote sensing can provide multiple independent techniques to monitor and verify forest parameters such as canopy height.

4. Quality Assessment

A +/- 2 m uncertainty was used for the canopy height estimates. This uncertainty was determined through previous studies.

Google Earth imagery was also used extensively as an additional reference for the circa 2014 land cover classification, but not for the circa 1990 classification, as no imagery was available for this area for any date prior to 2009.

A static +/- 1 year uncertainty was used for the stand age modeling.

5. Data Acquisition, Materials, and Methods

Site Description

The study site was the Rufiji River Delta in Tanzania.

Canopy height

Canopy height estimates (meters) were derived from a canopy height model (CHM) using TanDEM-X imagery and Polarimetric SAR interferometry (Pol-InSAR) techniques.

The TanDEM-X (TerraSAR-X add-on for Digital Elevation Measurements) mission forms a pair of satellite instruments that enable single-pass interferometry to generate a consistent global digital elevation model (DEM) (Krieger et al., 2007).

Polarimetric SAR interferometry (Pol-InSAR) technique is based on the coherent combination of both polarimetric and interferometric observables. In recent years, the quantitative models from Pol-InSAR data have been primarily demonstrated using airborne repeat-pass fully polarimetric interferometric systems over a variety of forests (e.g., boreal, temperate, and tropical forests) at L- and P-band, and more recently even at X-band. The TanDEM-X (TDX) mission allows the acquisition of satellite Pol-InSAR data at X-band without temporal decorrelation that is the most critical factor for a successful Pol-InSAR inversion in a conventional repeat-pass spaceborne or airborne SAR system (Lee and Fatoyinbo, 2015).

Mangrove forest cover change

Mangrove forest cover change was determined through of a post-classification comparison of 1990 and 2014 Landsat imagery for mangrove forest extent. To create these two classifications, training data were collected over mangrove and non-mangrove areas using image interpretation of circa 1990 and circa 2014 Landsat composites. The predominant band combination used for the visual interpretation was NIR (1.55-1.75 microm for TM, 0.85-0.88 microm for OLI), SWIR I (1.55-1.75 microm for TM, 1.57-1.65 microm for OLI), and SWIR II (2.08-2.35 microm for TM, 2.11-2.29 microm for OLI) loaded into the RGB channels, as this combination allowed us to discriminate forested areas easily. The Land Cover Change model estimated the current extent of mangroves (2014, Value = 1), gained areas of mangroves (1990-2014, Value = 2), and area of mangrove loss (1990-2014, Value = 3). No Data values are equal to zero.

Mangrove forest stand ages

Mangrove forest stand age was determined through comparison of annual mosaics of 1990 to 2014 Landsat imagery for mangrove forest extent. Google Earth imagery was also used extensively as an additional reference for the circa 2014 classification, but not for the circa 1990 classification, as no imagery was available for this area for any date prior to 2009. A static +/- 1 year uncertainty was used for the stand age modeling. This value was determined by the 1 year time overlap between annual mosaic images used in the analyses. The pixel value represents the age of the mangrove forests since 1994. No data values are equal to zero.

6. Data Access

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

CMS: Mangrove Canopy Characteristics and Land Cover Change, Tanzania, 1990-2014

Contact for Data Center Access Information:

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

7. References

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