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CMS: Terrestrial Lidar Scans of Mangrove Forests, Everglades NP, FL, USA, 2022-2023

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Documentation Revision Date: 2024-06-20

Dataset Version: 1

Summary

This dataset contains point clouds of three-dimensional (3D) mangrove forest structure and volume collected from 10 sites in Everglades National Park, Florida. Data were collected during NASA CMS "Blueflux" campaigns in March 2022, October 2022, and March 2023. Products were acquired using a RIEGL VZ-400i terrestrial laser scanner (TLS). TLS is a non-destructive and quantitative method for in situ 3D forest structure measuring and monitoring. Data are provided in LAS (*.las) format.

This dataset includes 264 files in LAS (*.las) format and one file in comma separated values (*.csv) format.

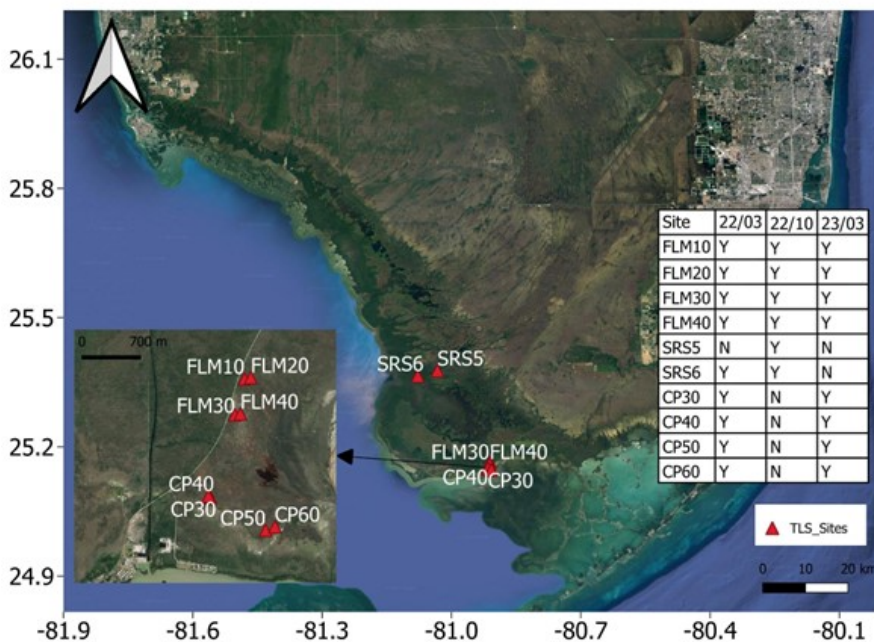


Figure 1. Terrestrial laser scanning (TLS) field sites in Everglades National Park, FL. FLM10, FLM20, FLM30, FLM40, CP30, CP40, CP50, CP60 are field sites in ghost forests. SRS5 and SRS6 are field sites along the Shark River Estuary.

Citation

Xiong, L., D. Lagomasino, and B. Poulter. 2024. CMS: Terrestrial Lidar Scans of Mangrove Forests, Everglades NP, FL, USA, 2022-2023. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2311>

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1. Dataset Overview

This dataset contains point clouds of three-dimensional (3D) mangrove forest structure and volume collected from 10 sites in Everglades National Park, Florida. Data were collected during NASA CMS "Blueflux" campaigns in March 2022, October 2022, and March 2023 (2022-03-20 to 2023-03-13). Products were acquired using a RIEGL VZ-400i terrestrial laser scanner (TLS). TLS is a non-destructive and quantitative method for in situ 3D forest structure measuring and monitoring.

Project: Carbon Monitoring System (CMS)

The NASA Carbon Monitoring System (CMS) program 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 uses 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 data products are designed to inform near-term policy development and planning.

Related Publication:

Poulter, B., F. M. Adams-Metayer, C. Amaral, A. Barenblitt, A. Campbell, S. P. Charles, R. M. Roman-Cuesta, R. D'Ascanio, E. R. Delaria, C. Doughy, T. Fatoyinbo, J. Gewirtzman, T. F. Hanisco, M. Hull, S. R. Kawa, R. Hannun, D. Lagomasino, L. Lait, S. L. Malone, P. A. Newman, P. Raymond, J. A. Rosentreter, N. Thomas, D. Vaughn, G. M. Wolfe, L. Xiong, Q. Ying, and Z. Zhang. 2023. Multi-scale observations of mangrove blue carbon ecosystem fluxes: The NASA Carbon Monitoring System BlueFlux field campaign. *Environmental Research Letters* 18:075009. <https://doi.org/10.1088/1748-9326/acdae6>

Acknowledgements:

These data were produced as part of the Blue Carbon Prototype Products for Mangrove Methane and Carbon Dioxide Fluxes (BLUEFLUX) project supported by NASA grant 80NSSC21K1564.

2. Data Characteristics

Spatial Coverage: Everglades National Park, Florida, USA

Spatial Resolution: point clouds with <1 cm spacing

Temporal Coverage: March 2022, October 2022, and March 2023

Temporal Resolution: Periodic measurements over three campaigns

Study Areas: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Everglades National Park, Florida, USA	-81.08	-80.91	25.38	25.14

Data File Information

This dataset includes 265 files. There are 264 files containing point cloud data in LAS files (*.las) format and one file in comma separated values (*.csv) format holding metadata about the LAS files.

The LAS files hold point clouds used for measuring three-dimensional (3D) mangrove forest structure and volume. The coordinate reference system (CRS) for the LAS files is UTM zone 17N (EPSG: 32617).

LAS files are named *Site_Day_ScanPos-SINGLESCANS-YYMMDD_TTTTTT.las* where:

- **Site** is the sample site name
- **Day** indicates whether a measurement was taken on the first or second day of sampling at a given site during a given campaign. 'Day1' is not present for sites that only had one day of measurement during a campaign.
- **ScanPos** indicates the scan position within a given site.
- **YYMMDD_TTTTTT** is the data and time of the measurement (e.g. 221018_111526 for Oct. 18, 2022 at 11:15:26 am)

Table 1. Data dictionary for *TLS_Mangrove_Forests_Everglades_File_Characteristics.csv*. Easting and northing coordinates are in UTM zone 17N (EPSG: 32617).

Variable	Units	Description
Filename	-	LAS filename
File_size_mb	mb	Size of LAS file in mb
Date	YYYY-MM-DD	Collection date
Number_of_records	1	Number of records (points)
Min_East	m	UTM easting for easternmost point
Max_East	m	UTM easting for westernmost point
Min_North	m	UTM northing for southernmost point
Max_north	m	UTM northing for northernmost point

Companion File

This dataset has one companion file, *TLS_Mangrove_Forests_Everglades_File_Characteristics.pdf*, that contains metadata characteristics of each LAS file. Characteristics include: file name, file size, collection date, number of records (points), and the geographic bounding box. These values match those

3. Application and Derivation

These 3D measurements from TLS scans provide information on stem density, vertical distributions of biomass, stand volume and surface area. The results can supplement field plot-based forest inventory data and provide surface area estimates for scaling chamber flux measurements (Calders et al., 2020). TLS data can also be used for calibration and validation of airborne and spaceborne lidar such as G-LiHT and GEDI.

4. Quality Assessment

The laser range accuracy for VZ-400i is 5 mm at 100 m distance. Co-registration accuracy is <2 cm. Georeferencing accuracy is dominated by accuracy of GNSS base stations, which is ~3 cm in ghost forest sites and ~10 cm in healthy forest sites (SRS5 and SRS6).

5. Data Acquisition, Materials, and Methods

Methods

A RIEGL VZ-400i terrestrial laser scanning (TLS) was used to collect point clouds for measuring forest structure at eight sites dominated by mangrove forest in Everglades National Park in Florida, USA. The sites cover a gradient of 'healthy' mangroves to recently disturbed and dying mangrove 'ghost forests'. The overall goal of the study was to investigate directional changes in carbon fluxes from forest losses and recovery (Poulter et al., 2023).

In ghost forest sites (FLM10, FLM20, FLM30, FLM40, CP30, and CP40), a Real-Time Kinematic based method was used for TLS data collection. The base station was setup at each field site and scan positions were measured using a rover GNSS unit mounted on top of the scanner. At sites with healthy forests (SRS5 and SRS6), two GNSS base stations were setup before scanning. All observations of GNSS base stations lasted more than 2 hours.

Laser wavelength of the TLS scanner was near infrared. Pulse repetition rate was set to 1200 kHz with a wide view of 100°x360° for scanning. At each site, TLS scans were collected at four corners, which were 10 m away from the plot center.

Co-registration and georeferencing were done in the software package RiSCAN PRO. Co-registration was used to align TLS scans to a local coordinate system. Automatic registration was first applied using the overlap point cloud between nearby scans. Multi station adjustment was later made to improve registration accuracy. For the TLS data in ghost forests, a freestation method was used that required at least four measured scan positions for georeferencing. For the TLS data in SRS5 and SRS6, the backsight registration method was used. This method only requires two measured positions of levelled scanners or reflectors (Xiong et al., 2017). For each scan, the georeferenced point cloud was exported in LAS format.

Additional details about methods and project results are available in Poulter et al. (2023).

6. Data Access

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

[CMS: Terrestrial Lidar Scans of Mangrove Forests, Everglades NP, FL, USA, 2022-2023](#)

Contact for Data Center Access Information:

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

7. References

Calders, K., J. Adams, J. Armston, H. Bartholomeus, S. Bauwens, L. P. Bentley, J. Chave, F. M. Danson, M. Demol, M. Disney, R. Gaulton, S. M. Krishna Moorthy, S. R. Levick, N. Saarinen, C. Schaaf, A. Stovall, L. Terry, P. Wilkes, and H. Verbeeck. 2020. Terrestrial laser scanning in forest ecology: Expanding the horizon. *Remote Sensing of Environment* 251:112102. <https://doi.org/10.1016/j.rse.2020.112102>

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