Aboveground Biomass and Cover, ALOS PALSAR ScanSAR, Greater Kruger NP, S Africa, 2018

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Dataset Version: 1

Summary

This dataset contains estimates of aboveground woody biomass density (AGBD) and woody canopy cover from the Greater Kruger National Park region, South Africa in September 2018 at 100-m resolution. Estimates were derived from data from the Phased Array L-band Synthetic Aperture Radar-2 (PALSAR-2) on the ALOS-2 ScanSAR using a Power Law Model (PLM) calibrated for natural savanna ecosystems. Training data for the PLM included AGBD and canopy cover from 1ha field plots derived from field measurements and Airborne laser scanning data. The PLM then used ALOS 2 PALSAR2 data to estimate AGBD and cover across the study area. This analysis was conducted as part of a NASA Carbon Monitoring System (CMS) project entitled SavannaBio: Biomass Estimation with New Spaceborne Missions for MRV in Dry Forests and Savannas.

This dataset contains two files in Cloud-optimized GeoTIFF (*.tif) format.

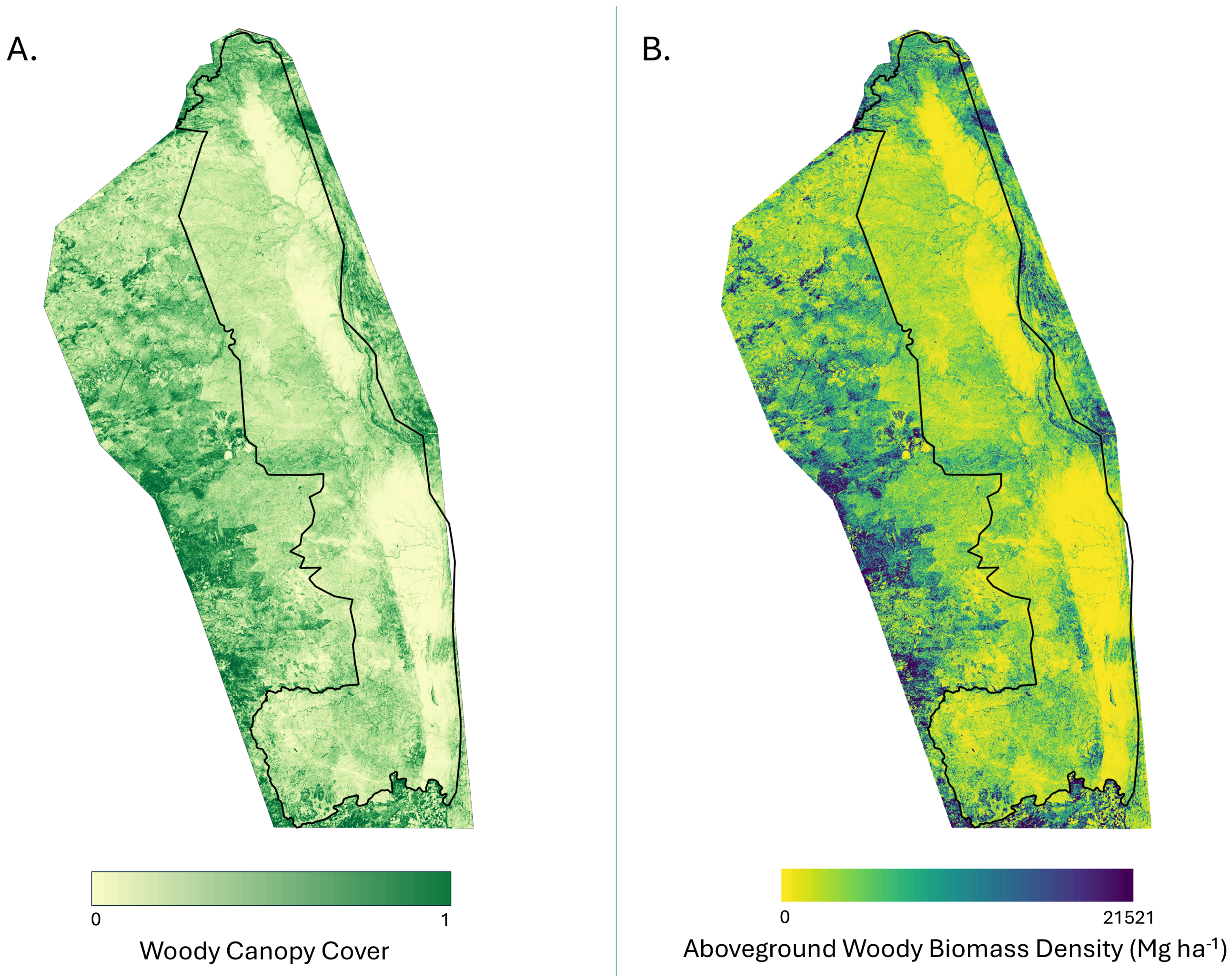

Figure 1. Woody canopy cover (Panel A) and aboveground woody biomass density (AGBD; Panel B) for Greater Kruger NP, South Africa. Products were derived from ALOS 2 PALSAR2 data using a Power Law model training with Airborne Laser Scanning data and 1ha AGBD field plots in the Lowveld of South Africa.

Citation

Wessels, K., and J. Armston. 2026. Aboveground Biomass and Cover, ALOS PALSAR ScanSAR, Greater Kruger NP, S Africa, 2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2512

Table of Contents

1. Dataset Overview

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Project: Carbon Monitoring System

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 an

Related Publication:

Li, X., K. Wessels, J. Armston, J., L. Duncanson, M. Urbazaev, L. Naidoo, R. Mathieu, and R. Main. 2024. Evaluation of GEDI footprint level biomass models in Southern African Savannas using airborne LiDAR and field measurements. Science of Remote Sensing. 10, 100161. https://doi.org/10.1016/j.srs.2024.100161

Wessels, K.J., M.J.S. Peel, I.P.J. Smit, J.D. Armston, X. Li, P. Lal, and M. Urbazaev. 2026. Assessing the impacts of changing elephant densities on woody vegetation structure in private reserves within the Greater Kruger National Park, South Africa. Biological Conservation. 317, 111815. https://doi.org/10.1016/j.biocon.2026.111815

Wessels, K., X. Li, A. Bouvet, R. Mathieu, R. Main, L. Naidoo, B. Erasmus, and G.P. Asner. 2023. Quantifying the sensitivity of L-Band SAR to a decade of vegetation structure changes in savannas. Remote Sensing of Environment 284, 113369. https://doi.org/10.1016/j.rse.2022.113369

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2. Data Characteristics

Spatial Coverage: Lowveld and Greater Kruger National Park, South Africa

Spatial Resolution: 100m

Temporal Coverage: September 2018 (2018-09-01 to 2018-09-30)

Temporal Resolution: One-time measurement

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Greater Kruger National Park, South Africa	30.1511	32.2669	-22.2212	-25.6148

This dataset contains two files in Cloud-optimized GeoTIFF (*.tif) format:

- Greater_Kruger_NP_AGBD_Biomass_2018.tif: Contains aboveground woody biomass density (AGBD) from Greater Kruger National Park, South Africa in September 2018. Biomass units are Mg Ha^{-1}. Note: AGBD is calibrated for natural savannas and values > 200 Mg/ha are likely attributed to small areas of commercial exotic plantations or very steep slopes that result in overestimation of AGBD and should not be used.
  - CRS: WGS 84 / UTM zone 36S (EPSG 32736)
  - Map units: Meters
  - Horizontal resolution: 100m
  - Bands: Band 1 (Aboveground Woody Biomass, Units: Mg Ha^{-1})
- Greater_Kruger_NP_Cover_2018.tif: Contains fractional woody canopy cover from Greater Kruger National Park, South Africa in September 2018.
  - CRS: WGS 84 / UTM zone 36S (EPSG 32736)
  - Map units: Meters
  - Horizontal resolution: 100m
  - Bands: Band 1 (Fractional Cover)

3. Application and Derivation

These estimates of AGBD and canopy cover from Lowveld and Greater Kruger National Park, South Africa provide insight to the carbon stocks of savannah ecosystems, which play a critical role in global carbon stocks, and provide additional insights into the ecology of savannah ecosystems.

4. Quality Assessment

Model calibration was performed using 70% of the dataset designated as the training set, with the remaining 30% used for validation. Validation returned good results (AGDB: R^2 = 0.58, RMSE = 14.07 Mg/ha and Cover R^2 = 0.55, RMSE = 0.19)

Residuals are centered around zero and therefore the models are considered to be unbiased (Wessels et al. 2026, Supplementary Information)

Limitations

The AGBD data are only applicable to the natural savanna vegetation for which the model was calibrated and the values in commercial forestry areas that may occur within the study area resulting in very high values. The methods show reduced sensitivity at very low AGBD values (< 15 Mg Ha^{-1}). Very steep slopes and hillsides resulted in very high backscatter values leading to overestimates of AGBD.

AGBD is calibrated for natural savannas and values > 200 Mg/ha are likely attributed to small areas of commercial exotic plantations or very steep slopes that result in overestimation of AGBD and should not be used.

5. Data Acquisition, Materials, and Methods

The data in this dataset were derived from Synthetic Aperture Radar-2 (PALSAR-2) data on the ALOS-2 ScanSAR using a Power Law model training with Airborne Laser Scanning data, and 1-ha AGBD field plots in the Lowveld of South Africa. The extent of the data included the Greater Kruger National Park, South Africa, for 2018.

Overview of modeling

The process of collecting and calculating the 1-ha plot AGBD and derived ALS AGBD is described in detail in (Li et al., 2024). The AGBD modeling was conducted after calculating the mean backscatter of 4 x 4 25-m ScanSAR pixels and assigning the mean to a new 100 x 100-m (1ha) grid. ScanSAR data provides wide spatial coverage (~350 km) and frequent revisit times (42 days) in the subtropics with high resolution (25m). ScanSAR data were pre-processed by the Japan Aerospace Exploration Agency, including ortho-rectification, slope correction and radiometric calibration. The 16-bit digital numbers (DN) were further converted to gamma-naught backscatter coefficients (γ^0) in power scale to avoid mathematical errors when using averaging or spatial convolution operations. Multi-speckle filtering was applied to reduce speckle effects. The speckled filtered γ^0 were finally converted from power scale to decibel unit (dB) scale.

The modeling workflow (Figure 2) involved: (i) estimating AGBD within 1-ha field plots, (ii) estimating AGBD with ALS canopy height model metrics (canopy cover and mean canopy height) inside 1-ha grid cell, and (iii) developing a Power Law model that predict AGBD from ScanSAR backscatter based on the widespread ALS-based AGBD as reference data.

Additional methodological details can be found in Wessels et al (2026 - including in the Supplementary Information) and Li et al (2024).

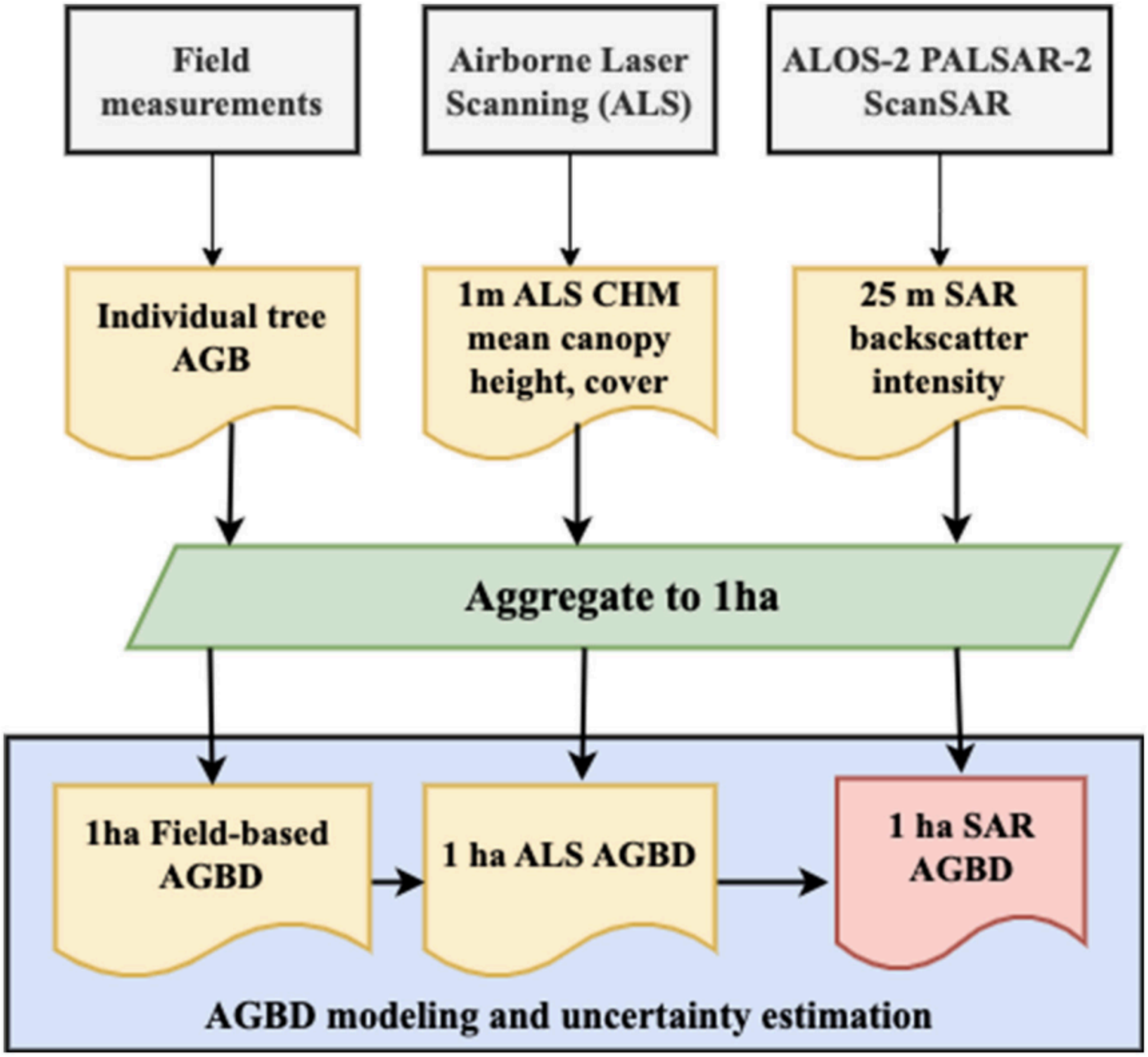

Figure 2. Data processing and modeling workflow (from Wessels et al., 2026)

6. References

Li, X., K. Wessels, J. Armston, J., L. Duncanson, M. Urbazaev, L. Naidoo, R. Mathieu, and R. Main. 2024. Evaluation of GEDI footprint level biomass models in Southern African Savannas using airborne LiDAR and field measurements. Science of Remote Sensing. 10, 100161. https://doi.org/10.1016/j.srs.2024.100161

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