

GEDI can accurately estimate canopy height in Savannas, but not for shrubs below 3m.

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Science Question

How accurately can GEDI estimate canopy height in short stature, discontinuous savanna vegetation, given that the sensor and algorithms were designed for tall dense forests?
Savannas are the third-largest carbon stock, covering 20% of land and are rapidly changing.

Analysis

Validation of GEDI (L2A, V2) relative height 98 (RH98) by comparing the on-orbit GEDI-RH98_{orb} to the simulated GEDI-RH98_{sim} derived from airborne LiDAR (ALS) data (Hancock et al. 2019) across 11 sites in South Africa.

Results

- Phenology, i.e. leaf-on vs. leaf-off conditions, had large impact on results (Fig. 1)
- In leaf-on conditions, GEDI's RH98_{orb} was very accurate between canopy heights 3 and 7 m with mean bias of -0.79 m (-10%) (Fig. 1).
- The mean bias increased from -1.2 m (-17%) to -2.7 m (-20%) from 7 to 13 m.
- GEDI's RH98_{orb} estimates, remained accurate in sparse canopy cover below 30%, unlike ICESat2.
- Algorithm setting group SG1 had the best performance, SG4&5 for dense forests had worst.
- Given the GEDI LiDAR pulse width of 15.6 ns, the GEDI-RH98 data product cannot reliably estimate canopy heights of shrubs below a theoretical minimum of 2.34 m.

Significance

First baseline validation of GEDI RH98 canopy height estimates in savannas.
Crucial insight into the lower limits of canopy height detection that impacts the measurement of shrub cover which is essential to ecological studies and biomass estimation in savannas.
GEDIs provide unique broad-area metrics of woody vegetation structure and aboveground biomass for regional ecological studies in savannas.

Acknowledgements

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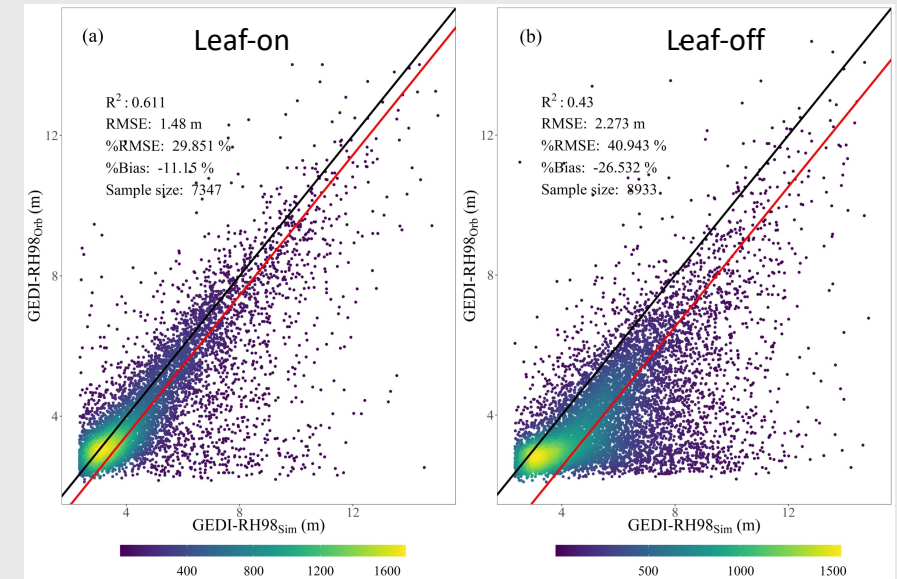


Figure 1. RH98_{sim} vs. RH98_{orb}. leaf-on (a) and leaf-off (b) conditions. The black 1:1 line, red line = mean bias.

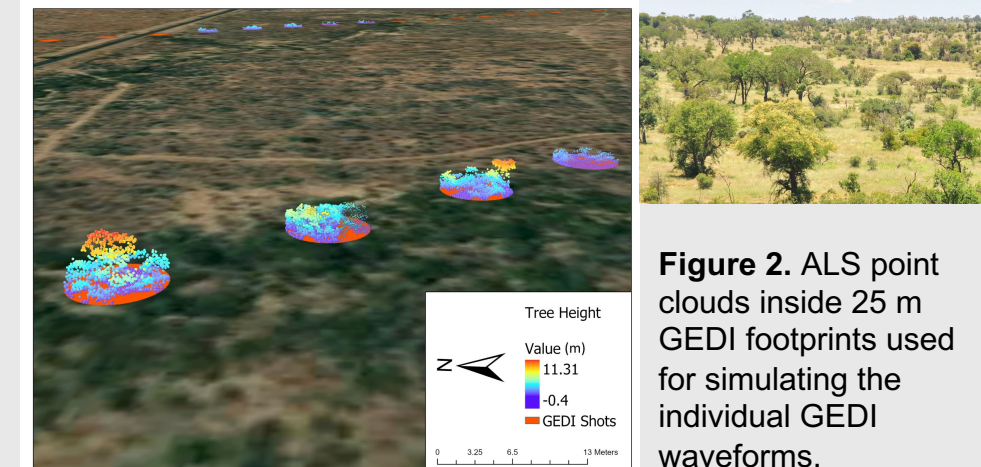


Figure 2. ALS point clouds inside 25 m GEDI footprints used for simulating the individual GEDI waveforms.