

Enhancing Biomass and Carbon Stock Estimation in Tanzanian Forest (TANZEO-BioStock Project)



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Introduction



In recent decades, growing concerns over climate change have underscored the need for accurate and scalable methods to estimate forest biomass and carbon stocks.

This project applies Earth Observation and machine learning techniques to estimate biomass and carbon in the West Usambara Mountains, Tanzania—one of the world's key conservation areas, rich in dense tropical rainforest cover.



Project goal and objectives



Overall goal

Estimate biomass and carbon stock by integrating field data, EO data and ML techiques.

Objectives

- Estimate above ground forest biomass
- Compare the accuracy of field measurement and RS-based methods
- Identifying corridors of high forest biomass and carbon stock to be preserved and potential areas to be replanted

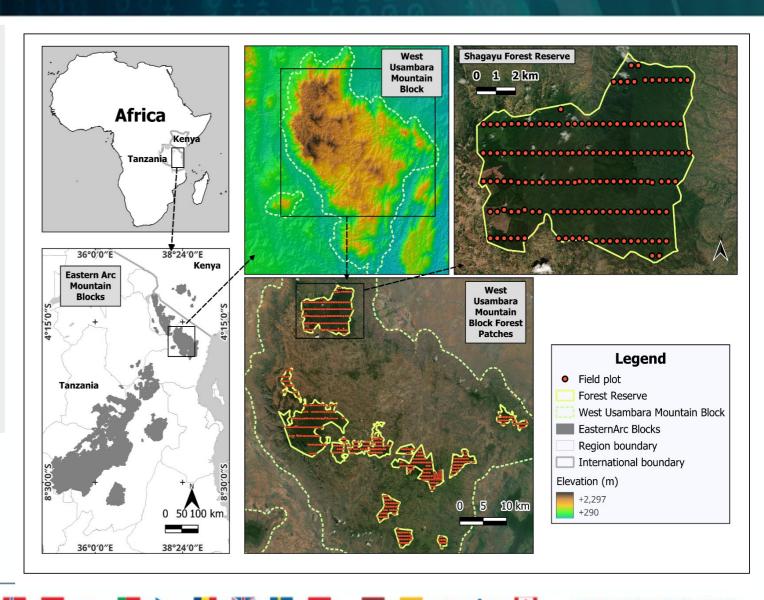




 West Usambara mountain forests block, Northen Tanzania. These mountains are part of the Eastern Arc Mountains (EAMs) which are group of isolated mountains stretching from Southeast Kenya to south central

Sampling Design

 Systematic sampling design was used to establish plots across the forests



Field data collection

esa

- A total of 806 field plots were established across the WUSMF.
- Out of these 164 were established at Shagayu Forest with the support of TANZEO-BIOSTOCK project.
 - In each plot all trees were measured for
 - Three trees were measured for height.
 - Central position of each plot was recorded.







Preliminary field data results

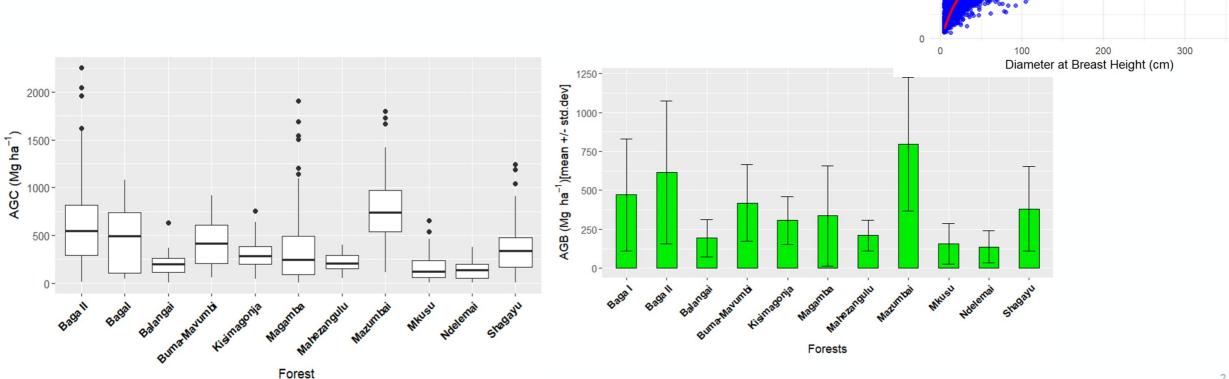


Tree Height-Diameter Model

75

Tree Height (m)

- Tree Height Diameter model developed.
- Plot based estimates for above ground biomass computed for 746 field plots.

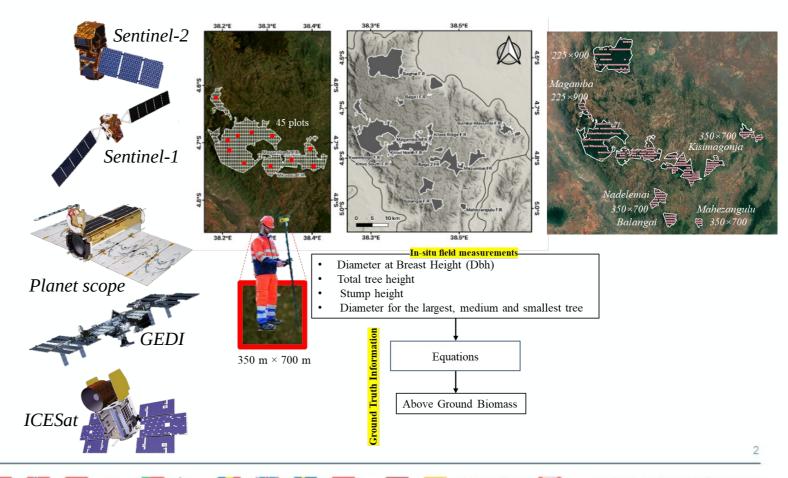




ESA and 3rd Party Mission Data

Sentinel-1, Sentinel-2
DEM-SRTM
Planet high-resolution imagery

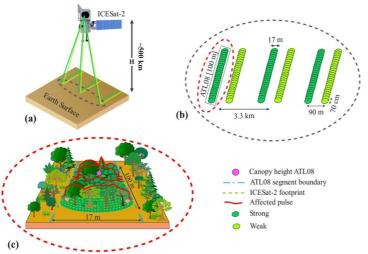
Non-ESA EO Data
 ICESat-2 ATLAS
 GEDI

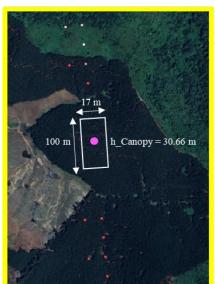


Overall Workflow



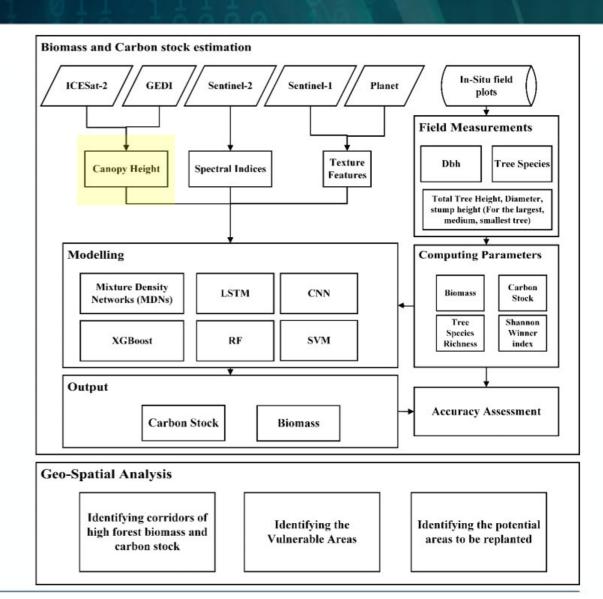






ATLAS/ICESat-2 ATL08 Land and Vegetation Height

canopy height values within a 100-m segment along the satellite's path, spanning 17-m across its trajectory.

















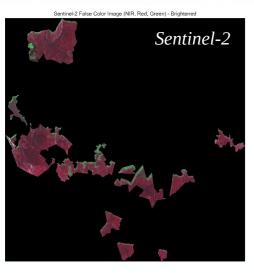


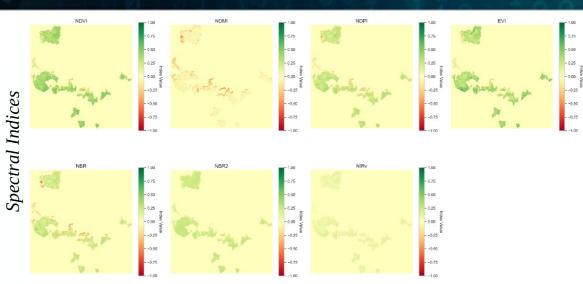


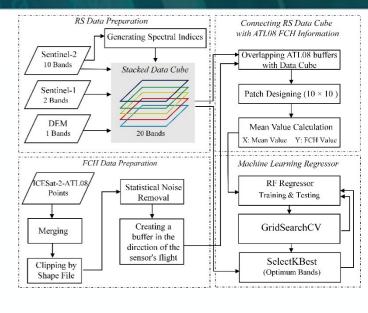


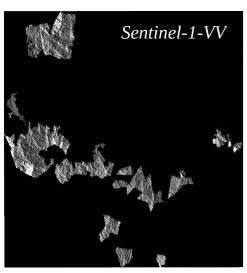


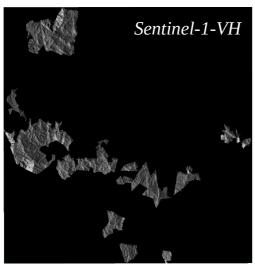


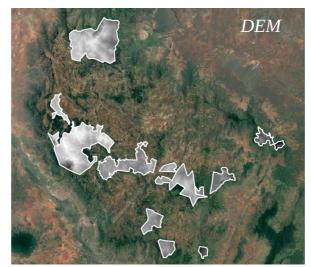


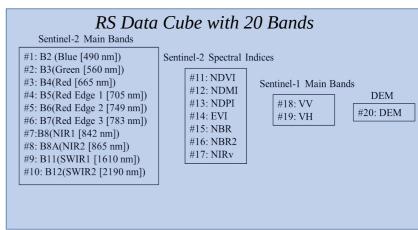








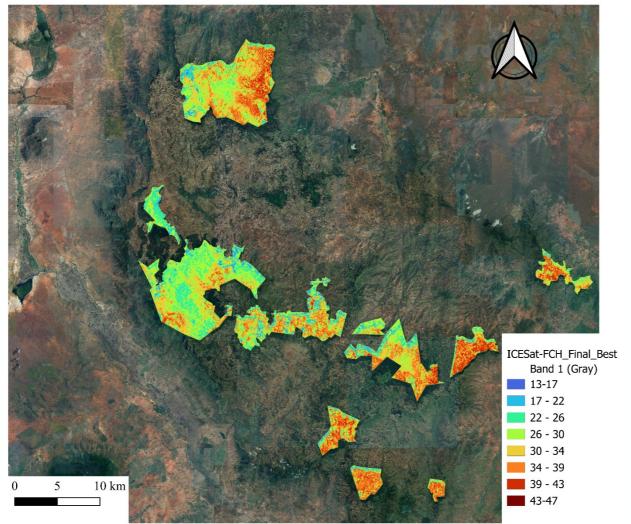


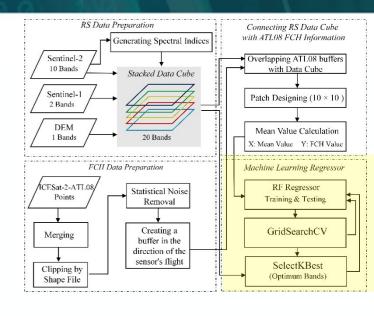


Forest Canopy Height (Wall-to-Wall MAP Generation)



FCH wall-to-wall map



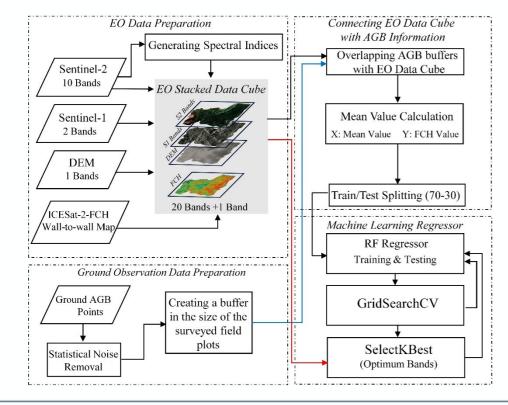


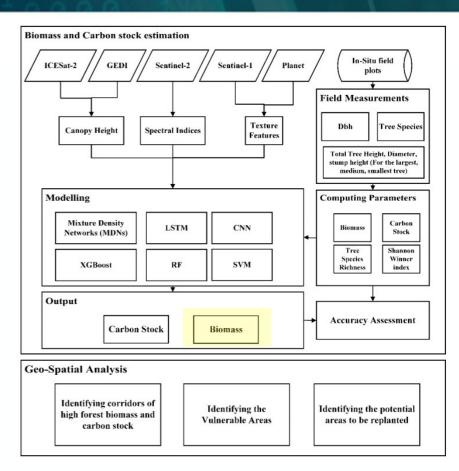
Above Ground Biomass Estimating



List of datasets utilized in AGB Estimating

Name	Acquisition time	Spatial resolution	Temporal resolution
ICESat-2-FCH	2024-10-13/2024-11-03/2024-11-11	10 m	91 days
Sentinel-2	Median Image (2024-10-01:2024-11-30)	10 m	5 days
Sentinel-1	Median Image (2024-10-01:2024-11-30)	10 m	6 days
DEM-SRTM	2024-09-21	30 m	-

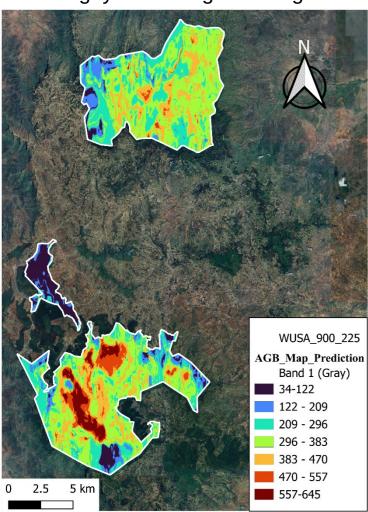




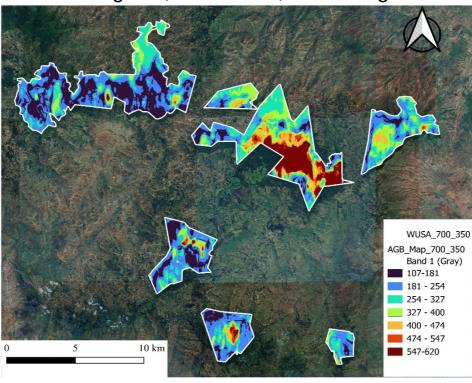
Above Ground Biomass Estimating

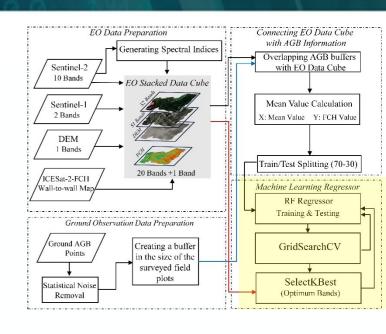


Shagayu and Magamba regions



Kisimagonia, Nadelemai, Mahezangulu







Thank you