

10. LiDAR and Multi-source EO data in the spatial estimation of biomass

Aim

To reduce uncertainty in spatial biomass estimation (one of the GCOS ECVs) using three-dimensional forest stand structure information from LiDAR point clouds.

Scope

Satellite remote sensing data from optical and microwave sensors have been used in combination with field plots to estimate biomass. However, these approaches are limited by signal saturation above moderate biomass density and the relatively large uncertainties that arise from various steps in the estimation process.

The reference data that is used to regionalize remote sensing measurements, the field data, contributes significantly to the total uncertainty of spatial biomass estimates. LiDAR has strong linkages to spatial biomass and is devoid of any saturation issues. Another major source of field-level uncertainty in biomass estimation is the allometric models used for tree-level biomass estimations – developing methods for the non-destructive estimation of tree volume using Terrestrial LiDAR can overcome this.

Current Constraints/Challenges

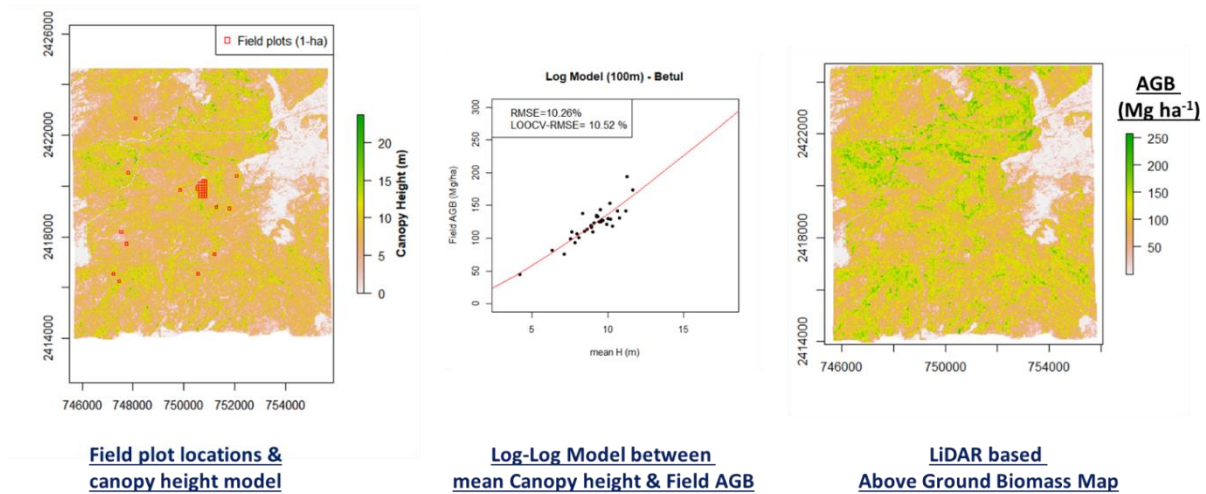
- A key challenge is in the inventory and characterization of reference plots which could be overcome by:
 - i) The development of methods for automated measurement of trees in inventory plots using mobile and terrestrial LiDAR
 - ii) The development of non-destructive allometric models using Terrestrial LiDAR
 - iii) the development of tree-centric methods for regionalization.
- Direct tree inventory using computer vision and AI/ ML methods applied to very high (<1m spatial resolution) for the temporal monitoring of biomass in ToF and plantations is a key challenge.

Expected Outcome

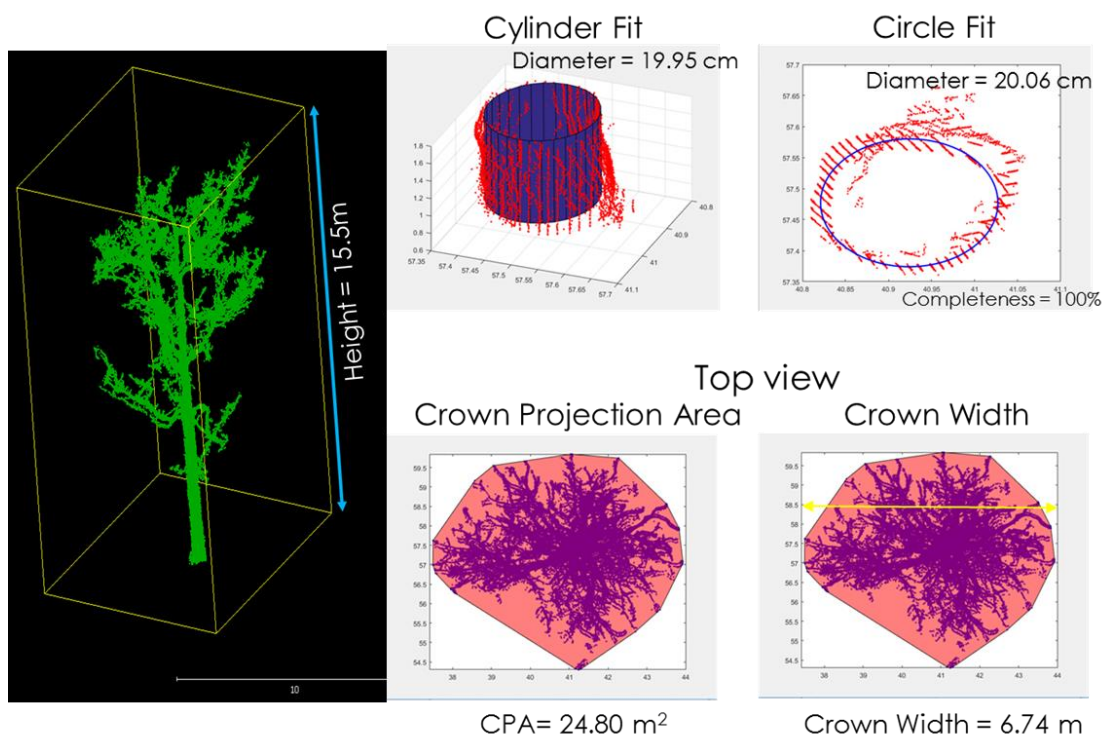
High-quality reference biomass datasets using a large plot network over Aerial LiDAR coverage for calibration and validation of current and future EO missions (viz., NISAR, BIOMASS, GEDI, etc.)

Time Frame 3 - 5 years.

Betul, Madhya Pradesh, Dry Deciduous Forests



The LiDAR aided reference above ground biomass map (AGB) for dry deciduous forest site in Betul, Madhya Pradesh, Central India.



Tree measurements derived using 3D virtual tree reconstruction from TLS point clouds.