3D-FOREST

Novel in-situ 3D forest structure and biomass estimates to validate air/spaceborne products

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30/01/2018 BEODay

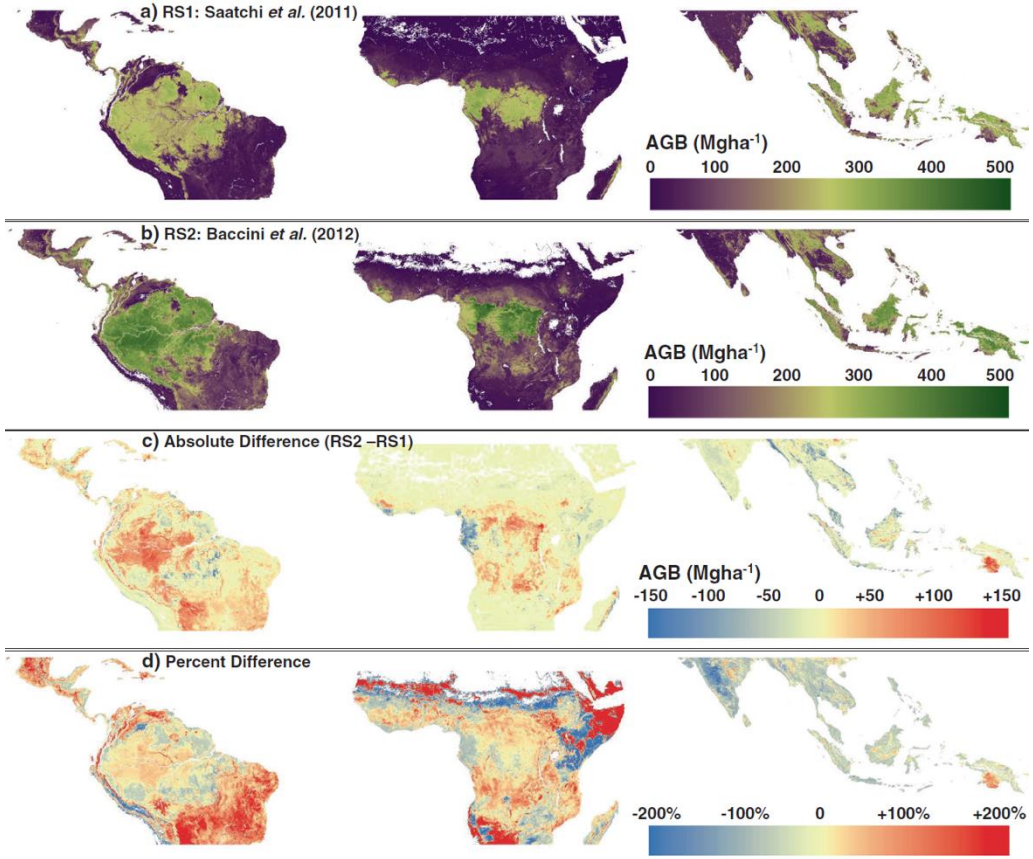
Research topic & project relevance

Global distribution of terrestrial carbon is highly uncertain

➔ BUT these estimates are important for:

- Effective forest management
- Climate mitigation actions

Disagreement of two tropical biomass maps ➔ need for better ground validation:



Source: Mitchard et al., 2013 (CBM)

Research topic & project relevance

Ideally ➔Direct measurements

Research topic & project relevance

In practice ➔ use allometry:

- Size to mass relationships
- Find relationships between volume (diameter D, height H) & mass

BUT: allometry relies on VERY limited measurements of trees we have actually cut down and weighed

Research topic & project relevance

Can we do better? ➔ weighing trees with lasers:

Rapid and robust ground reference data of full 3D structure

Research topic & project relevance

Can we do better? ➔ weighing trees with lasers:

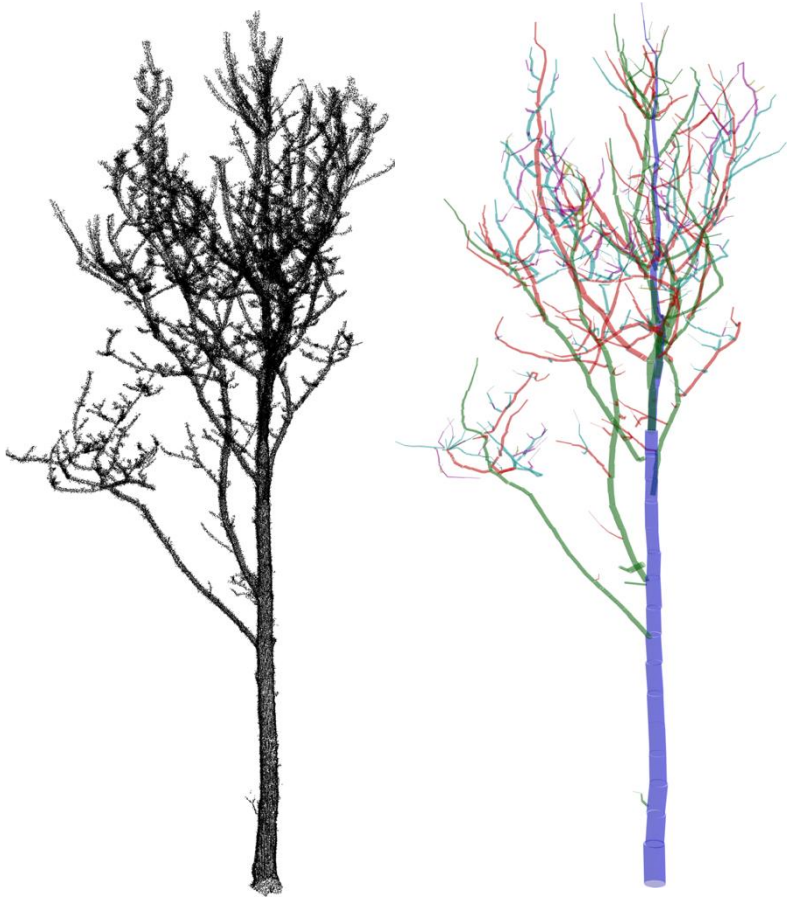
Example of Terrestrial LiDAR (TLS) point cloud:

MetEOC2 project

Concepts and methods

Tree extraction

Tree reconstruction

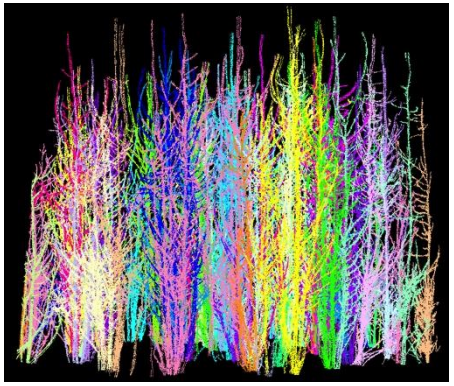


Objectives of 3D-FOREST

OBJECTIVE 1:

Improving estimates of plot-level AGB using terrestrial LiDAR

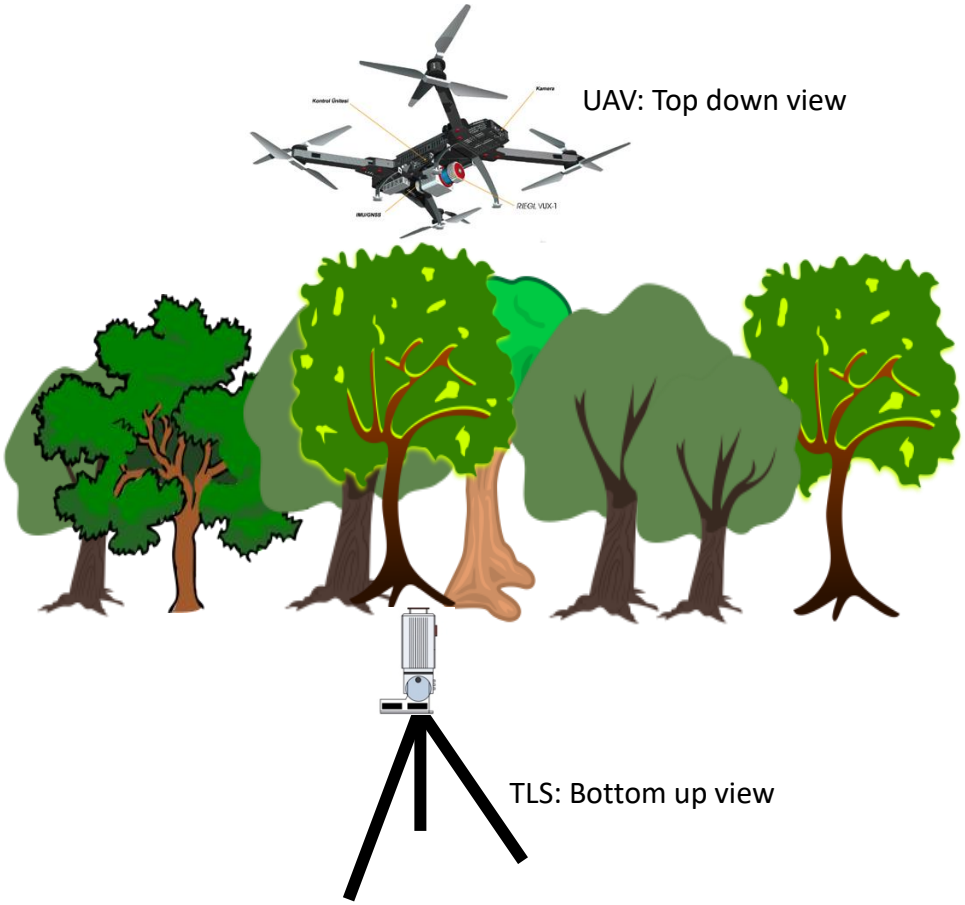
Ecosystems	Location	TLS acquisition & processing	Forest inventory available
Natural tropical forests	Pan-tropical	Completed (by WUR, UCL, UGent)	Yes
Semi-managed temperate forests	Wytham Woods, UK	Completed (by K. Calders UCL)	Yes
Managed poplar plantation	Belgium, Lochristi	Completed (by UGent)	Yes (incl. destructive harvesting)

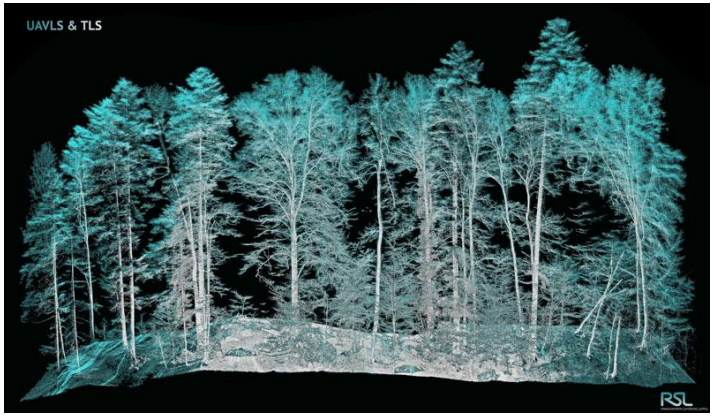


Objectives of 3D-FOREST

OBJECTIVE 2:

Upscaling LiDAR derived AGB and forest structure to larger areas





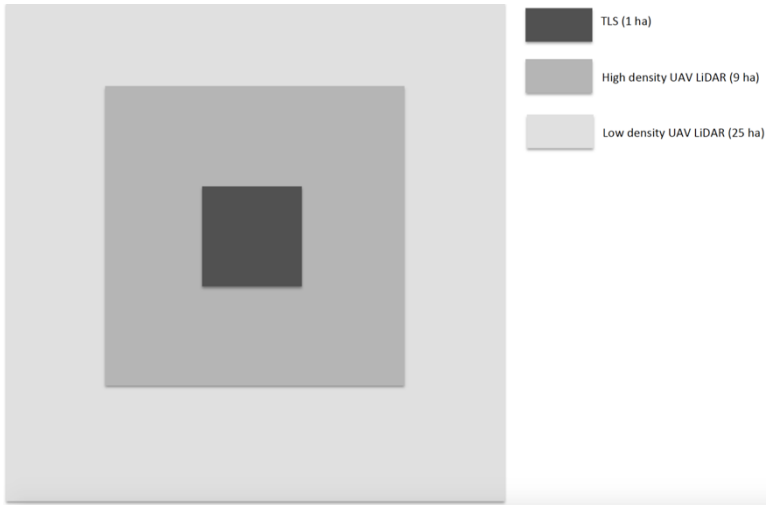
Source: http://www.geo.uzh.ch/en/units/rsl/Research.html

Objectives of 3D-FOREST

OBJECTIVE 2:

Upscaling LiDAR derived AGB and forest structure to larger areas

Various ecosystems (TERN network)	Australia
Semi-managed temperate forest (SONIA, BELAIR site)	Belgium, Zoniën



- Contrasting sites and ecosystems: woodland to rainforest
- Good site set-up and infrastructure for UAV take-off/landing
- Forest inventory and other data available

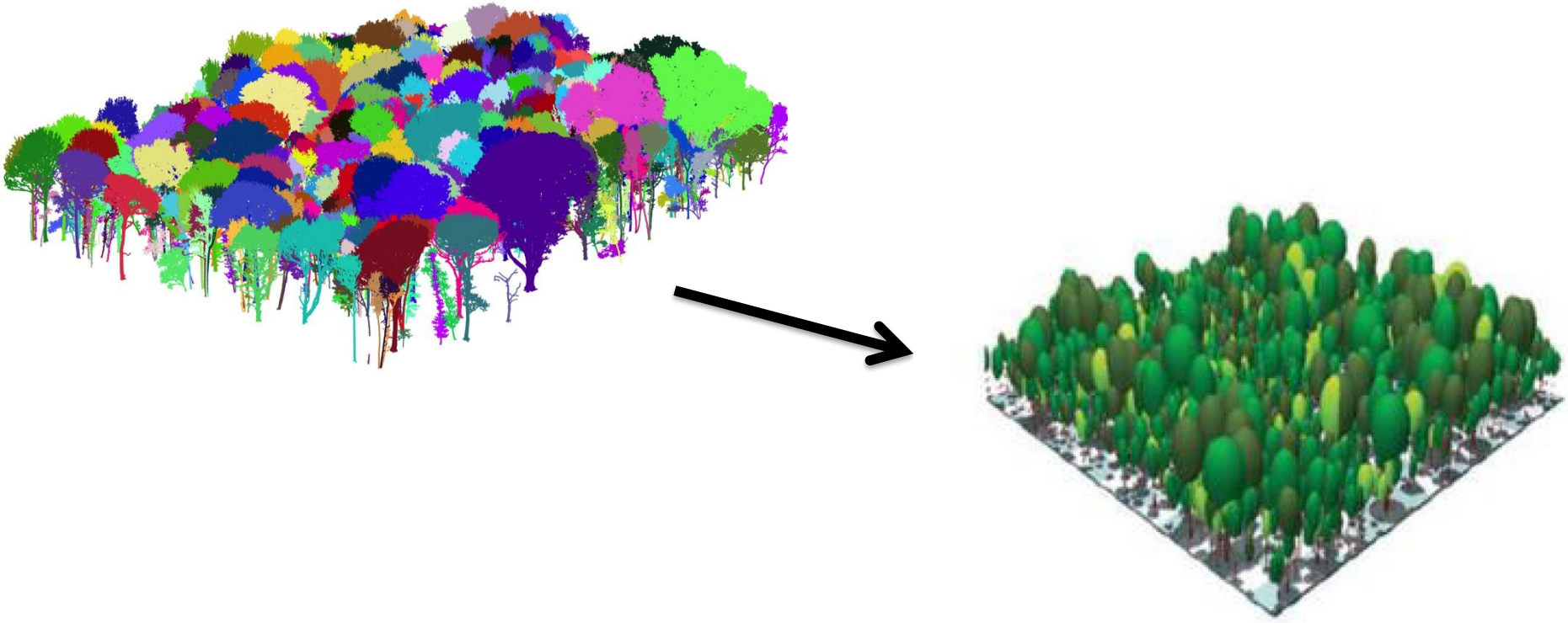
... And lots of paperwork..

Objectives of 3D-FOREST

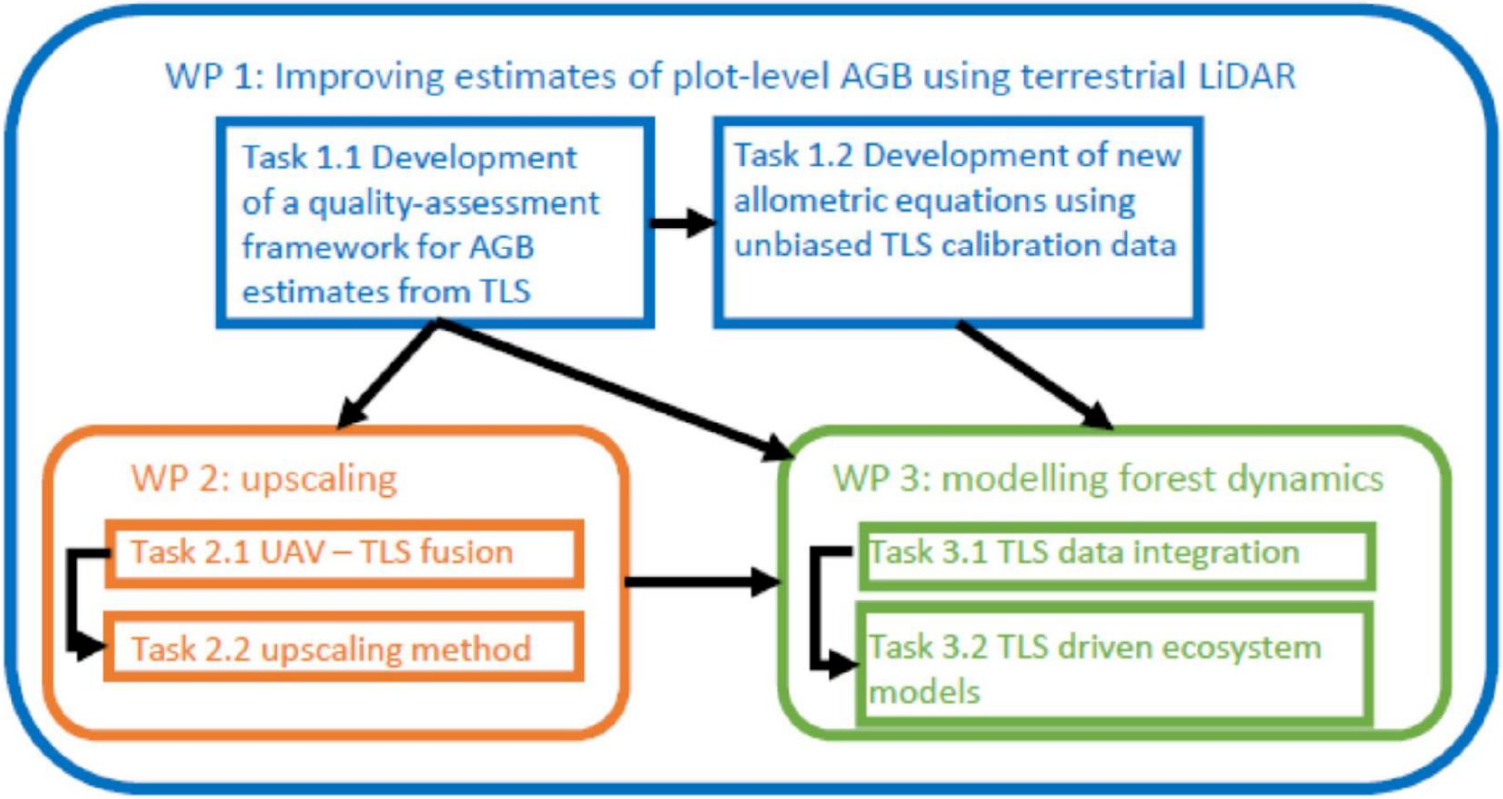
OBJECTIVE 3:

Improving estimates of forests growth function dynamics using LiDAR derived AGB and structure

- How do we link 3D LiDAR data to ecosystem models?



WORKPLAN


WP 1: Improving estimates of plot-level AGB using terrestrial LiDAR
Task 1.1 Development of a quality-assessment framework for AGB estimates from TLS
Task 1.2 Development of new allometric equations using unbiased TLS calibration data
WP 2: upscaling
Task 2.1 UAV – TLS fusion
Task 2.2 upscaling method
WP 3: modelling forest dynamics
Task 3.1 TLS data integration
Task 3.2 TLS driven ecosystem models

Innovation

1. Novel quality assessment framework for 3D volume estimates
2. New allometric equations using unbiased calibration data
3. New insights into upscaling and spatial distribution of AGB and structure
4. Unique co-incident TLS – UAV LiDAR dataset covering a range of ecosystems
5. Proof-of-concept of improved forest growth modelling

- AGB is a new focus area in the CEOS land product validation group

- 3 upcoming spaceborne missions focusing on AGB:
  - GEDI (2019, NASA)
  - BIOMASS (2020, ESA)
  - NISAR (2020, NASA-ISRO)

  ➔ **Success of these missions ~ quality of the ground data (cal/val)**

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