Fusion of UAV and terrestrial laser scanning data to assess tree-and stand-level leaf and wood properties

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Introduction

- The popularization of LiDAR technology, and notably the possibility to multiply acquisition viewpoints thanks to Unmanned aerial vehicles (UAVs) opens-up new opportunities in forest ecology research. High temporal frequency of LiDAR coverage allowed by UAV systems provides a way of monitoring phenology overtime at the individual crown scale. We can now envisage the calibration of architecture/growth models and carbon allocation models for numerous tropical species, while accounting for local biotic interactions and microclimatic variations.
- We introduce here preliminary results on the potential of ULS to describe vegetation profiles and compare them with other LiDAR technologies (TLS and ALS).

Material

- LiDAR data were acquired in **French Guyana** (Paracou) and **Cameroon** (Bouamir)
- A range of sensors and platforms were used

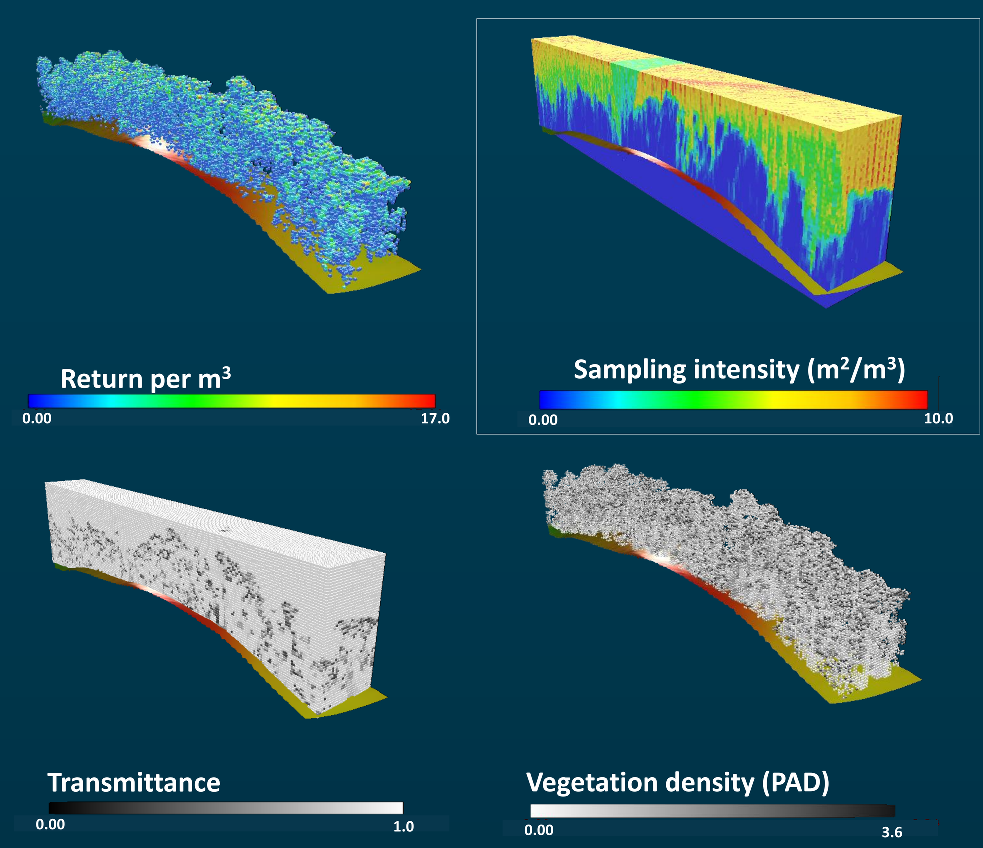
Platform	Sensor	λ (nm)	Height (m)	Footprint at 100m (mm)
UAV (ULS)	Riegl Minivux	905	70 & 90	80
Terrestrial (TLS)	Riegl VZ400	1550	1.5	35
Terrestrial (TLS)	Leica C10	532	1.5	13
Plane (ALS)	Riegl LMS-Q560	1550	500	50
Plane (ALS)	Riegl LMS-Q780	1064	900	25

Methods

Amapvox: From point cloud to vegetation density

By tracing each lidar pulse emitted and all the returns triggered (and their back-scattered energy) AMAPvox generates a 3D map of vegetation transmittance from which Plant Area Density is computed.

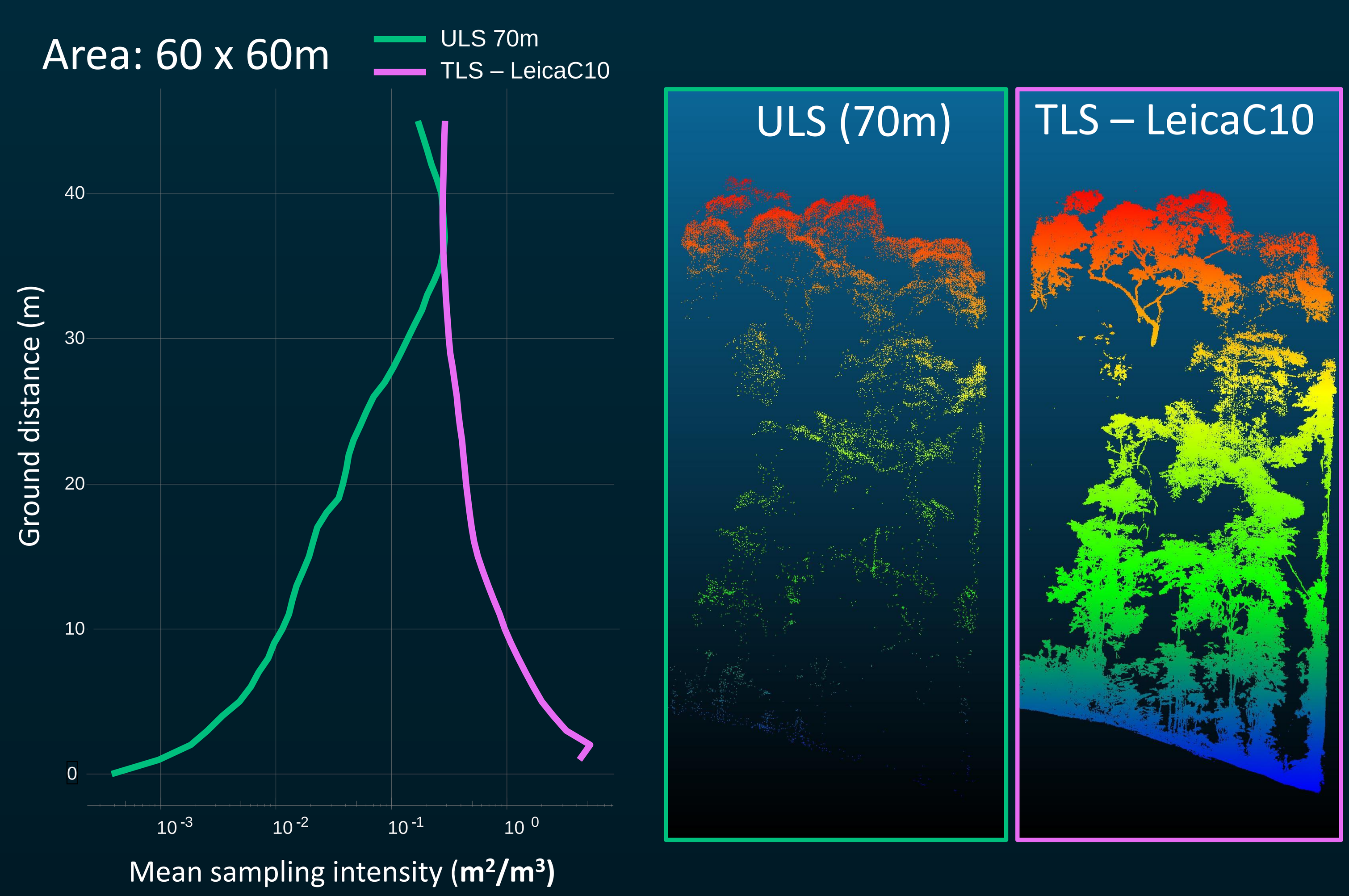
Please visit www.amapvox.org



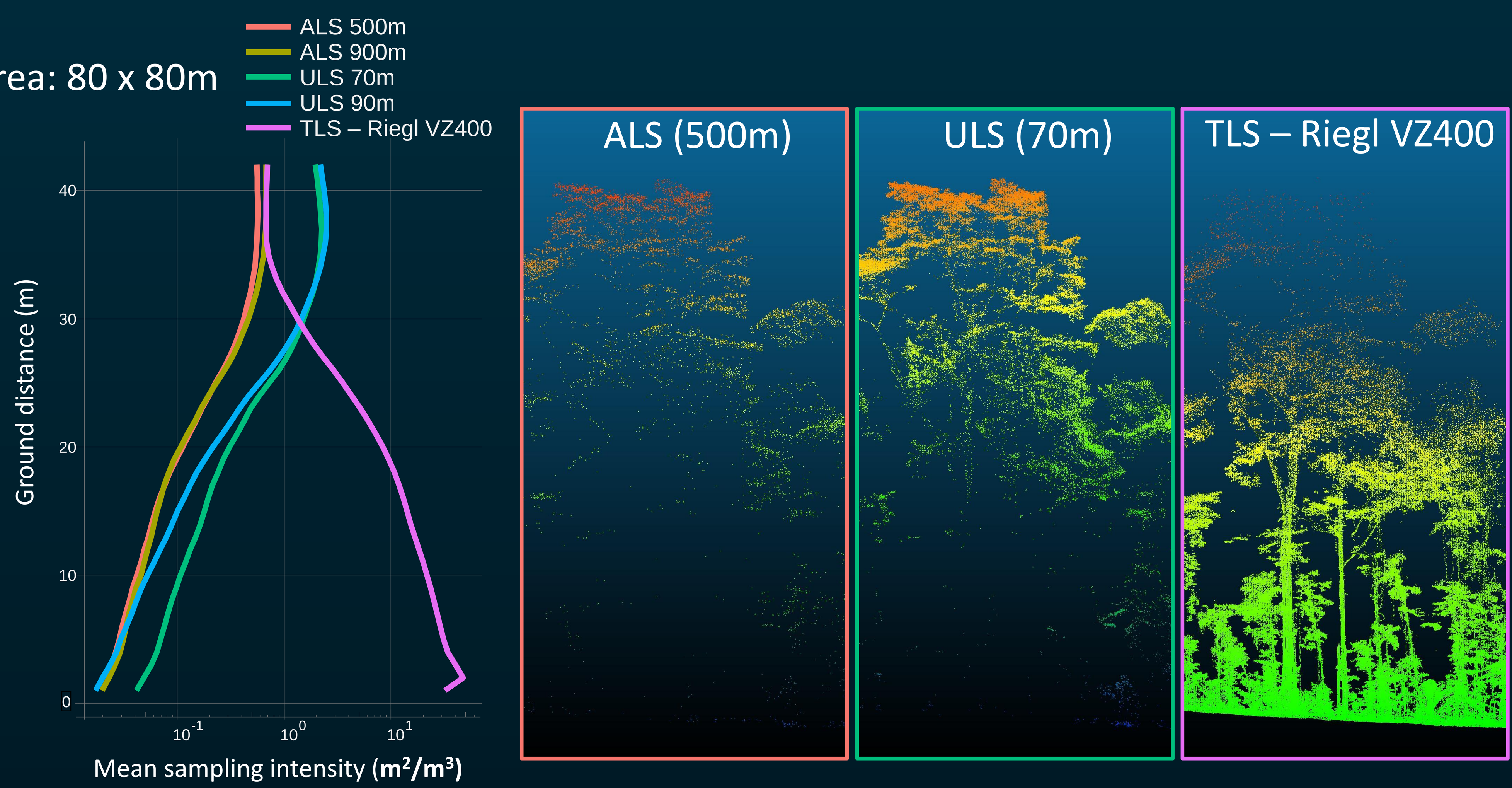
Preliminary results

- We present a first characterisation of mean sampling intensity offered by the different platforms/sensors
- TLS VZ400 seems to have a lesser penetration in the canopy than TLS Leica C10
- ULS data offer a better sampling across the whole profile than reference ALS data.
- ULS data present little interest for describing branches and trunks, even for emerging trees

Area: 60 x 60m



Area: 80 x 80m



Conclusion – Perspectives

The interest of fusion between ULS and TLS is most obvious :

- For completing sampling of TLS scanners having a limited penetration (Riegl VZ400)
- For characterizing **leaf area** and **crown sizes** over significant extents (1000 ha) or repetitively (phenology)

Accounting for variations in sampling densities (e.g. with AMAPVox) is fundamental to obtain a meaningful description of leaf/plant area across the vertial profile.

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