Fusion of UAV and terrestrial laser scanning data to assess tree-and stand-level leaf and wood properties
Nicolas Barbier, Guillaume Delaitre, Olivier Martin-Ducup, Philippe Verley, Grégoire Vincent

To cite this version:
Nicolas Barbier, Guillaume Delaitre, Olivier Martin-Ducup, Philippe Verley, Grégoire Vincent. Fusion of UAV and terrestrial laser scanning data to assess tree-and stand-level leaf and wood properties. Terrestrial laser scanning in forest ecology, May 2019, Gent, Belgium. hal-02445339

HAL Id: hal-02445339
https://hal.umontpellier.fr/hal-02445339
Submitted on 23 Jan 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Fusion of UAV and terrestrial laser scanning data to assess tree- and stand-level leaf and wood properties

Nicolas Barbier, Guillaume Delaitre, Olivier Martin-Ducup, Philippe Verley, Gregoire Vincent
UMR AMAP CIRAD - TA AS2/P52 34398 Montpellier cedex 5 (France)

Contact: nicolas.barbier@ird.fr

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

<table>
<thead>
<tr>
<th>Platform</th>
<th>Sensor</th>
<th>λ (nm)</th>
<th>Height (m)</th>
<th>Footprint at 100m (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAV (ULS)</td>
<td>Riegl Minivux</td>
<td>905</td>
<td>70 &amp; 90</td>
<td>80</td>
</tr>
<tr>
<td>Terrestrial (TLS)</td>
<td>Riegl VZ400</td>
<td>1550</td>
<td>1.5</td>
<td>35</td>
</tr>
<tr>
<td>Terrestrial (TLS)</td>
<td>Leica C10</td>
<td>532</td>
<td>1.5</td>
<td>13</td>
</tr>
<tr>
<td>Plane (ALS)</td>
<td>Riegl LMS-Q560</td>
<td>1550</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>Plane (ALS)</td>
<td>Riegl LMS-Q780</td>
<td>1064</td>
<td>900</td>
<td>25</td>
</tr>
</tbody>
</table>

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

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 vertical profile.