Towards the prediction of wood resource in tropical forests from TLS and ALS

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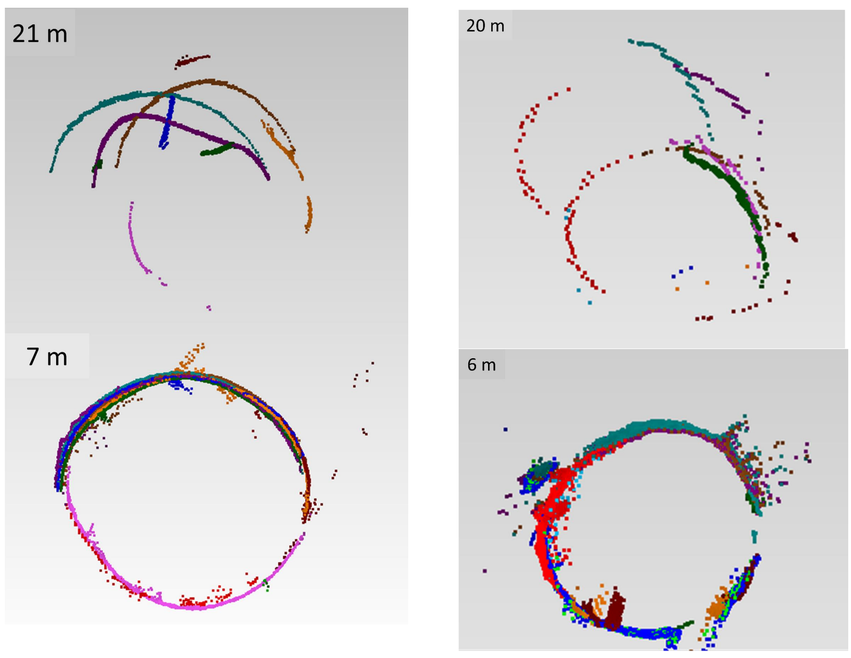
STEM VOLUME ESTIMATION : COPING WITH WIND AND OCCLUSION

- ❑ *Dicorynia guianensis* emergent trees were scanned at Paracou Research station in French Guiana with a Faro Focus 3D.
- ❑ Two cases of TLS points distorsion by wind :



TLS points are segmented and shown at two stem heights; they are colored by separate scans.

- ❑ Wind may introduce inaccuracies to the estimation of stem volume performed from TLS multi-scan point clouds. We compare here four methods for 3 trees with noticeable wind problems

Difference to the field measurement

Method	Multiple scans	Single scan	Standard deviation *between singles scans*
Automatic	0,13	0,34	0,42
Manual	0,12	0,14	0,26

- ❑ Result : When confronted to windy conditions, a manual correction seem necessary to prevent underestimation of the volume.

The low error we get with manual estimation on singles scans may be an hint to improve efficiency on the field and take only fewer scans when confronted to non favorable conditions.

PERSPECTIVES : IMPROVING GEOMETRICAL FITTING

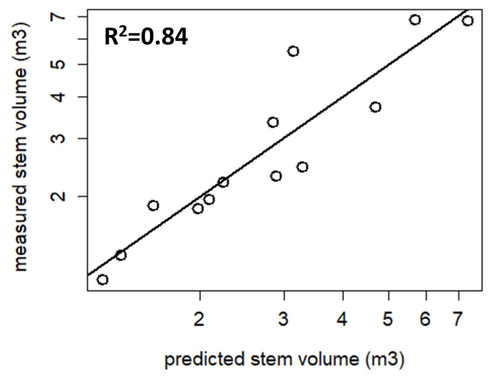
- ❑ Processing chain of (Pitkanen et al. 2019) : tree stems are first modelled as cylinders which are used for further circle fitting procedures using co-registered data or single scans.
- ❑ STEP method (Ravaglia et al. 2017) : combining a Hough transform and a new form of growing active contour model (”snakes”) to detect and reconstruct complex tubular shapes in dense, noisy and occluded point clouds.

Ravaglia, J., et al. (2017). "Extraction of tubular shapes from dense point clouds and application to tree reconstruction from laser scanned data." Computers & Graphics **66**: 23-33.
Pitkänen, T. P., et al. (2019). "Measuring stem diameters with TLS in boreal forests by complementary fitting procedure." ISPRS Journal of Photogrammetry and Remote Sensing **147**: 294-306..

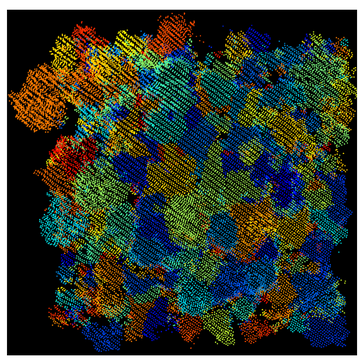
CALIBRATING ALLOMETRIC MODEL WITH TLS

- ❑ Terrestrial lidar acquisitions (TLS) will provide a reference database for calibrating species-specific allometric models.

- ❑ Prediction of stem volume (V) from tree height (H) and crown width (CW) :
  - Preliminary dataset : 13 *Dicorynia g.* trees
  - V is estimated from field measures of stem diameter
  - H and CW are extracted from TLS point clouds
  - Log-linear model : $\log(V) = a + b \log(H) + b' \log(CW) + \varepsilon$
  - Predicted vs. measured stem volume : $R^2 = 0.84$



PREDICTING WOOD RESOURCE FROM ALS AND THR PHOTO

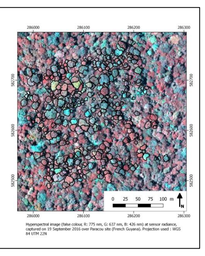


Segmented ALS point cloud

Segmentation algorithms are used to delineate individual tree crowns in ALS point cloud.

Classification algorithms are computed on hyperspectral image
⇒ discrimination of tree species with high accuracy (Laybros 2019)

Laybros, A., et al. (2019). "Across Date Species Detection Using Airborne Imaging Spectroscopy." Remote Sensing **11**(7): 789.



Metrics like height and crown dimensions are extracted for each tree
=> prediction of timber stem volume

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