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Crown segmentation using Airborne Laser Scanning data in a silvopastoral system with *Eucalyptus grandis*

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Airborne Laser Scanning (ALS) remote sensing holds immense potential for characterizing and measuring forest biomass, providing a valuable inventory tool for intensive silviculture to enhance forest management and planning. Accurate estimation of total height (Ht) and crown area (CA) is crucial to model and design silvopastoral systems. The main objective of this study was to estimate Ht and CA accurately using watershed segmentation algorithm in a triple-row silvopastoral system with *Eucalyptus grandis*, to compare these variables based on the position of the tree in the rows. Edge trees are the most prevalent in a triple row silvopastoral system, making it important to analyze and understand their structural differences from the trees in the interior. The study was conducted in a silvopastoral system in Reboledo, Florida, Uruguay (34° 1'15.16"S, 55° 39'13.75"W). The silvopastoral system consisted of triple rows of *Eucalyptus grandis* N-S oriented lined with natural pastures in 14-19 m alleys. ALS data was obtained from an area of 26 ha including two silvopastoral stands planted in 2012 (10 years) and 2019 (4 years). From the canopy height model (CHM) a Watershed segmentation algorithm was conducted to obtain individual tree segmentation, yielding Ht and CA of individual trees in both stands. Individual trees were manually classified by position in the triple row as Middle (M), External West (EW) and External East (EE). Our results show data of 1,627 individual trees in the 2019 stand and 1,405 trees in the 2012 stand, EW trees showed the highest CA in the 2019 stand with a 10% difference with M trees and a 9% with EE trees. The 2019 plot showed no significant difference in Ht. In the 2012 stand, EE trees showed the highest CA with a 22% difference from M trees and an 8% with EW, and EW trees showed a 15% higher CA than M tress in the 2012 stand. The 2012 plot showed a 1% significant average difference between Externals and Middle trees and no significant difference between EE and EW trees. Correlation between field data and ALS data in Ht showed $R2=0.82$, $n=45$ and $p<0.0001$ in 2019 plot, and $R2=0.67$, $n=18$, and $p<0.0001$ in the 2012 plot. Watershed segmentation algorithm in combination with ALS remote sensing demonstrated to be an efficient method to estimate CA and Ht in triple-row silvopastoral systems.

Keywords: agroforestry, crown area, CHM, tree height, watershed algorithm, LiDAR