

Accuracy of LiDAR-based tree height estimation and crown recognition in a subtropical evergreen broad-leaved forest in Okinawa, Japan

ABSTRACT

Aim of study: To present an approach for estimating tree heights, stand density and crown patches using LiDAR data in a subtropical broad-leaved forest.

Area of study: The study was conducted within the Yambaru subtropical evergreen broadleaved forest, Okinawa main island, Japan.

Materials and methods: A digital canopy height model (CHM) was extracted from the LiDAR data for tree height estimation and a watershed segmentation method was applied for the individual crown delineation. Dominant tree canopy layers were estimated using multiscale filtering and local maxima detection. The LiDAR estimation results were then compared to the ground inventory data and a high resolution orthophoto image for accuracy assessment.

Main results: A Wilcoxon matched pair test suggests that LiDAR data is highly capable of estimating tree height in a subtropical forest ($z = 4.0$, $p = 0.345$), but has limitation to detect small understory trees and a single tree delineation. The results show that there is a statistically significant different type of crown detection from LiDAR data over forest inventory ($z = 0$, $p = 0.043$). We also found that LiDAR computation results underestimated the stand density and overestimated the crown size.

Research highlights: Most studies involving crown detection and tree height estimation have focused on the analysis of plantations, boreal forests and temperate forests, and less was conducted on tropical and/or subtropical forests. Our study tested the capability of LiDAR as an effective application for analyzing a highly dense forest

Keyword: Broad-leaved; Inventory; LiDAR; Subtropical; Tree height