Geophysical Research Abstracts
Vol. 20, EGU2018-7278, 2018
EGU General Assembly 2018

Derivation of tree height and crown radius based on different airborne remote sensing data

Selina Ganz

Forest Research Institute of Baden-Württemberg, Department of Biometrics, Germany (Selina.Ganz@Forst.bwl.de)

Advanced remote sensing technologies are capable to detect single tree parameters to assist and improve forest inventories. The aim of this study was to derivate tree height and mean crown radius from a variety of airborne remote sensing data. The key contribution was to analyze the impact of point cloud quality and the resolution of height models on calculation accuracy of the aforementioned parameters. The study area was located in a Douglas fir stand in the Black Forest in Baden-Württemberg, Germany.

Unmanned aerial vehicle (UAV) photogrammetric and LiDAR-based point clouds, ultralight aircraft photogrammetric point clouds of different processing quality and photogrammetric point clouds from a standard image flight were acquired. Point cloud densities ranged between 4 points/m^2 and 2372 points/m^2. For the derivation of the single tree parameters canopy height models (CHMs) were used with a geometric resolution of 10 cm, 20 cm, 50 cm and 1 m, respectively.

Tree height was extracted from the highest value within a crown boundary delineated with the CHM. Crown radius was calculated as the average of eight values measured along eight directions with 45° interval from the location of each tree top by fitting a fourth-degree polynomial on each of the resulting height profiles. Ground truth data was collected for crown radius on 34 standing trees and for tree height after felling on 15 lying trees.

For tree height, root-mean-square errors (RMSEs) varied by dataset ranging from 0.38 m to 2.89 m (RMSE% 1.12 – 8.52). The best results were achieved with UAV-based LiDAR data with a RMSE of 0.38 m. LiDAR data overestimated tree height about 0.13 m whereas photogrammetric data underestimated tree height with mean errors (MEs) between -0.37 m and -2.71 m. The RMSEs for crown radius varied from 0.49 m to 0.81 m (RMSE% 12.22 – 20.20). The best results were achieved with LiDAR data with a RMSE of 0.49 m and a ME of -0.07 m. The developed method underestimated crown radius with a ME between -0.07 m and -0.44 m. The accuracy of photogrammetric based data differed as a function of point cloud density. Higher point cloud density improved estimation accuracy for both parameters. The geometric resolution of the CHM was irrelevant for the calculation of tree height and played only a secondary role for the calculation of crown radius.

Overall, the accuracies of the results were promising and showed that the methods were feasible for detecting tree height and mean crown radius. Furthermore, the developed methods have the potential to supplement future research directed towards the derivation of other single tree based parameters.