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Integrating Airborne LiDAR and Terrestrial Laser Scanner forest parameters for accurate estimation of above-ground biomass/carbon in Ayer Hitam tropical forest reserve, Malaysia

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Parameters of individual trees can be measured from LiDAR data provided that the laser points are dense enough to distinguish tree crowns. Retrieving tree parameters for above-ground biomass (AGB) valuation of the complex biophysical tropical forests using LiDAR technology is a major undertaking, and yet needs vital effort. Integration of Airborne LiDAR Scanner (ALS) and Terrestrial Laser Scanner (TLS) data for estimation of tree AGB at a single-tree level has been investigated in part of the tropical forest of Malaysia. According to the complete tree-crown detection potential of ALS and TLS, the forest canopy was cross-sectioned into upper and lower canopy layers. In a first step, multiresolution segmentation of the ALS canopy height model (CHM) was deployed to delineate upper canopy tree crowns. Results showed a 73% segmentation accuracy and permissible to detect 57% of field-measured trees. Two-way tree height validations were executed, viz. ALS-based upper and TLS-based lower canopy tree heights. The root means square error (RMSE) for upper canopy trees height was 3.24m (20.18%), and the bias was –1.20m (–7.45%). For lower canopy trees height, RMSE of 1.45m (14.77%) and bias of 0.42m (4.29%) were obtained. In a second step, diameter at breast height (DBH) of individual tree stems detected from TLS data was measured. The RMSE obtained was 1.30cm (6.52%), which was as nearly accurate as manually measured-DBH. In a third step, ALS-detected trees were co-registered and linked with the corresponding tree stems detected by TLS for DBH use. Lastly, an empirical regression model was developed for AGB estimated from a field-based method using an independent variable derived from ALS and TLS data. The result suggests that traditional field-methods underestimate AGB or carbon with the bias –0.289 (–3.53%) Mg, according to approximately 11%. Conversely, integrative use of ALS and TLS can enhance the capability of estimating more accurately AGB or carbon stock of the tropical forests.

Biography

Muluken N Bazezew received a BSc degree in Forestry from Hawassa University, Ethiopia in 2010. He also received MSc degree in Environmental Science (Energy and Climate Change) from Addis Ababa University, Ethiopia in 2014. Most recent of his educational background is MSc degree in Geo-Information Science and Earth Observation from University of Twente, Faculty of Geo-information Science and Earth Observation (ITC), the Netherlands in 2017. Currently, he is a geospatial expert and working as Lecturer and Researcher at Dilla University of Ethiopia since 2010. He is expertise in the application of earth observation data in natural resources, environment, and agriculture. Current research interest is the application of medium to very high-resolution images, LiDAR technologies (ALS and TLS) and Unnamed Aerial Vehicle (UAV) in natural resources and agricultural monitoring.

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