Models for aboveground forest carbon stock estimation in tropical region using airborne lidar

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Abstract

Quantification of amount of carbon stored in tropical forests remains challenging and retains greatest uncertainties in understanding their role in the global carbon cycle. This uncertainty demands methods that can accurately and precisely measure forest carbon dynamics and provide carbon density map for a larger geographic extent. In this study, we examined LiDAR derived forest parameters with field measured data and developed general and specific AFCS models for a tropical forest that comprised of a variety of natural and plantation forests in Sumatra, Indonesia. The general models are developed including all types of natural and plantation forests while the specific models are fitted to the specific forest type, i.e. peat swamp and dry moist forests, regrowth, mangrove, rubber, acacia, oil palm, and coconut. To cover these variations of forest type, eight LiDAR transacts crossing 60 field plots were acquired for calibrating the models. The field plots consisted of AFCS ranging from 4 – 161 Mg /ha. The calibrated LiDAR to AFCS general model enabled to predict the AFCS with R^2 = 0.87 and root mean square errors (RMSE) = 17.4 Mg /ha. The specific AFCS models provided carbon estimates, varied by forest types, with R^2 ranging from 0.72 – 0.97 and uncertainty (RMSE) ranging from 1.4 – 10.7 Mg /ha. Using these models, AFCS maps were prepared for the LiDAR coverage that provided AFCS estimates for 8,000 ha offering larger ground sampling measurements for calibration of SAR based carbon mapping model to wider region of Sumatra.

Keywords: Forest carbon; AFCS; AGB; biomass modeling; REDD+; natural forest; plantation forest, LiDAR