Estimating aboveground biomass changes in a human-modified tropical montane forest of Borneo using multi-temporal airborne LiDAR data

ABSTRACT

Estimating aboveground biomass changes in tropical mountains is difficult due to the small-scale anthropogenic land use activities such as selective logging. This study examined how multitemporal airborne LiDAR data could estimate AGB changes in Borneo's tropical montane forest. Using airborne LiDAR data acquired in 2012 and 2017, we compared direct and indirect approaches to estimating the AGB changes. The direct method predicts the AGB change directly based on differences in LiDAR variables between the two time points whereas, the indirect method first constructs a model for predicting the AGB for each time point and then estimates the changes. The direct approach produced a model with an adjusted R2 of 0.321 and a relatively high RMSE (6.37 Mg/ha/year; relative RMSE: 134.36%). On the other hand, annual AGB changes derived from the indirect approach had a low RMSE value (1.413 Mg/ha/year; relative RMSE: 29.80%) and were strongly correlated with the field AGB changes (R2 = 0.988). We estimated the AGB changes using the indirect approach to be − 7.49 Mg/ha/year for AGB loss and 8.91 Mg/ha/ year for AGB gain. We identified land use conversion as the primary driver of AGB changes in the montane forest since the rate of AGB decrease in state-land was higher than in the managed forest. The LiDAR-based approach provides high-resolution estimates of AGB changes by enlarging field plots to more extensive area coverage, facilitating the adoption of incentive-based carbon conservation mechanisms.