# ESTIMATING TREE HEIGHT AND ABOVE GROUND BIOMASS OF TROPICAL RAINFOREST ACROSS DIFFERENT DEGRADATION LEVELS IN MALAYSIAN BORNEO USING AIRBORNE LIDAR DATA

Keiko Ioki[1], Satoshi Tsuyuki[1], Keigo Hoshimoto[1], Mui-How Phua[2], Zia-Yiing Ling[2], Wilson Wong[2], Alexius Korom[2], Berhaman Ahmad[2], Normah A. Besar[2], Yasumasa Hirata[3], Hideki Saito[3], Gen Takao[3]

[1]*Graduate School of Agricultural and Life Sciences, University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113-8567, Japan, aaioki@ mail.ecc.u-tokyo.ac.jp*
[2]*School of International Tropical Forestry, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia*
[3]*Forest and Forest Products Research Institute, Matsunosato 1, Tsukuba, Ibaraki 305-8687, Japan*

**Abstract:** In tropical regions, forests continue to decrease and degrade due to human activities such as conversion to agricultural land, illegal/legal logging. The resulting carbon emission has been recognized as one of the major causes of climate change. REDD+ (Reducing emissions from deforestation and forest degradation in developing countries - *plus*) is the mechanism that gives an incentive for conserving and enhancing carbon stocks in such forested areas. For successful REDD+ implementation, accurate estimation of carbon stock is required in national/sub-national scale. It is widely acknowledged that airborne LiDAR data provide promising estimation for above ground biomass (AGB). However, methods and applicability are yet to be fully examined in tropical forests. This study aims to explore the use of airborne LiDAR data for estimating tree height (Lorey's mean height: mean height weighted by basal area) and AGB in tropical rainforest over mountainous terrain in Sabah, Malaysia. Field data were collected in 50 sample plots which contain a wide range of degradation levels with different disturbance history. Degradation level (Old growth, Moderately degraded, and Highly degraded) for each plot was determined through species composition by Chao dissimilarity index and field observed AGB. Several LiDAR height indices including quadratic mean canopy height (QMCH) and mean canopy height were derived and regression analyses were carried out for tree height and AGB estimation. The performance of the estimation models using extracted indices was studied and the best model was selected. For the height and the AGB estimation, the model using median canopy height and mean canopy height resulted in the greatest coefficient of

determination ($R^2$), respectively. The results from AGB estimation were also compared with the Landsat-5/TM image classification. In conclusion, it was revealed that the airborne lidar data were able to produce highly accurate estimation.

Keyword: Above ground biomass, Lidar, Canopy height