Aboveground biomass changes in tropical montane forest of Northern Borneo estimated using spaceborne and airborne digital elevation data

ABSTRACT

Monitoring anthropogenic disturbances on aboveground biomass (AGB) of tropical montane forests is crucial, but challenging, due to a lack of historical AGB information. We examined the use of spaceborne (Shuttle Radar Topographic Mission Digital Elevation Model (SRTM) digital surface model (DSM)) and airborne (Light Detection and Ranging (LiDAR)) digital elevation data to estimate tropical montane forest AGB changes in northern Borneo between 2000 and 2012.LiDAR canopy height model (CHM) mean values were used to calibrate SRTM CHM in different pixel resolutions (1, 5, 10, and 30 m). Regression analyses between field AGB of 2012 and LiDAR CHM means at different resolutions identified the LiDAR CHM mean at 1 m resolution as the best model (modeling efficiency=0.798; relative root mean square error=25.81%). Using the multi temporal AGB maps, the overall mean AGB decrease was estimated at 390.50 Mg/ha, but AGB removal up to 673.30 Mg/ha was estimated in the managed forests due to timber extraction. Over the 12 years, the AGB accumulated at a rate of 10.44 Mg/ha/yr, which was attributed to natural regeneration. The annual rate in the village area was 8.31 Mg/ha/yr, which was almost 20% lower than in the managed forests (10.21 Mg/ha/yr). This study identified forestry land use, especially commercial logging, as the main driver for the AGB changes in the montane forest. As SRTM DSM data are freely available, this approach can be used to estimate baseline historical AGB information for monitoring forest AGB changes in other tropical regions.