Seeing trees from space: above-ground biomass estimates of intact and degraded montane rainforests from high-resolution optical imagery

ABSTRACT

Accurately quantifying the above-ground carbon stock of tropical rainforest trees is the core component of "Reduction of Emissions from Deforestation and Forest Degradation-plus" (REDD+) projects and is important for evaluating the effects of anthropogenic global change. We used high-resolution optical imagery (IKONOS-2) to identify individual tree crowns in intact and degraded rainforests in the mountains of Northern Borneo, comparing our results with 50 ground-based plots dispersed in intact and degraded forests, within which all stems > 10 cm in diameter were measured and identified to species or genus. We used the dimensions of tree crowns detected in the imagery to estimate above-ground biomasses (AGBs) of individual trees and plots. To this purpose, preprocessed IKONOS imagery was segmented using a watershed algorithm; stem diameter values were then estimated from the cross-sectional crown areas of these trees using regression relationships obtained from ground-based measurements. Finally, we calculated the biomass of each tree (AGBT, in kg), and the AGB of plots by summation (AGBP, in Mg ha-1). Remotely sensed estimates of mean AGBT were similar to ground-based estimates in intact and degraded forests, even though small trees could not be detected from space-borne sensors. The intact and degraded forests not only had different AGB but were also dissimilar in biodiversity. A tree-centric approach to carbon mapping based on high-resolution optical imagery, could be a cheap alternative to airborne laser-scanning.