CONTROL ID: 1495058

TITLE: Automated Detection of Selective Logging in Amazon Forests Using Airborne Lidar Data and Pattern Recognition Algorithms

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ABSTRACT BODY: Selective logging, the removal of several valuable timber trees per hectare, is an important land use in the Brazilian Amazon and may degrade forests through long term changes in structure, loss of forest carbon and species diversity. Similar to deforestation, the annual area affected by selected logging has declined significantly in the past decade. Nonetheless, this land use affects several thousand km^2 per year in Brazil. We studied a 1000 ha area of the Antimary State Forest (FEA) in the State of Acre, Brazil (9.304 $^{\circ}$S, 68.281 $^{\circ}$W) that has a basal area of 22.5 m^2 ha^{-1} and an above-ground biomass of 231 Mg ha^{-1}. Logging intensity was low, approximately 10 to 15 m^3 ha^{-1}. We collected small-footprint airborne lidar data using an Optech ALTM 3100EA over the study area once each in 2010 and 2011. The study area contained both recent and older logging that used both conventional and technologically advanced logging techniques. Lidar return density averaged over 20 m^{-2} for both collection periods with estimated horizontal and vertical precision of 0.30 and 0.15 m. A relative density model comparing returns from 0 to 1 m elevation to returns in 1-5 m elevation range revealed the pattern of roads and skid trails. These patterns were confirmed by ground-based GPS survey. A GIS model of the road and skid network was built using lidar and ground data. We tested and compared two pattern recognition approaches used to automate logging detection. Both segmentation using commercial eCognition segmentation and a Frangi filter algorithm identified the road and skid trail network compared to the GIS model. We report on the effectiveness of these two techniques.

KEYWORDS: [0439] BIOGEOSCIENCES / Ecosystems, structure and dynamics, [0480] BIOGEOSCIENCES / Remote sensing, [0428] BIOGEOSCIENCES / Carbon cycling.

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