DISTRIBUTION OF CARBON STORED IN PAN-TROPICAL FORESTS FROM FUSION OF FIELD INVENTORY AND REMOTE SENSING DATA

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1. Abstract

Estimates of greenhouse gas (GHG) emissions resulting from deforestation require information on both the area of forest loss and the corresponding carbon stocks of the lands that are cleared. We developed a spatially explicit 'benchmark' map of above- and belowground forest carbon stocks across the tropics for the early 2000s by using about 4000 ground inventory plots, 150,000 biomass values estimated from heights measured by spaceborne lidar, and a suite of satellite imagery products. Our forest carbon estimates are spatially refined at a 1-km grid cell resolution and are directly comparable across countries and regions. When combined with locations where deforestation has occurred, the map will provide improved estimates of baseline emissions from tropical deforestation. In this study, We combined three types of data to develop a spatially explicit map of forest carbon: (1) biomass values estimated for 4,087 ground inventory plots larger than 1-ha and distributed over three continents [1,890 plots in Latin America (LA), 1,589 in Africa (AF) and 608 in South Asia (SA)]; (2) 150,449 measurements of height (RH100) measured by the GLAS lidar sensor aboard the ICESAT satellite from which aboveground forest biomass values were estimated using allometric equations derived from inventory data in each region; and (3) Thirteen satellite image layers at 1-km resolution, used to extrapolate the ground and lidar biomass values over the three continents. The satellite images represent various metrics of canopy structure, greenness, moisture, and surface topography derived from MODIS, QSCAT, and SRTM satellites.

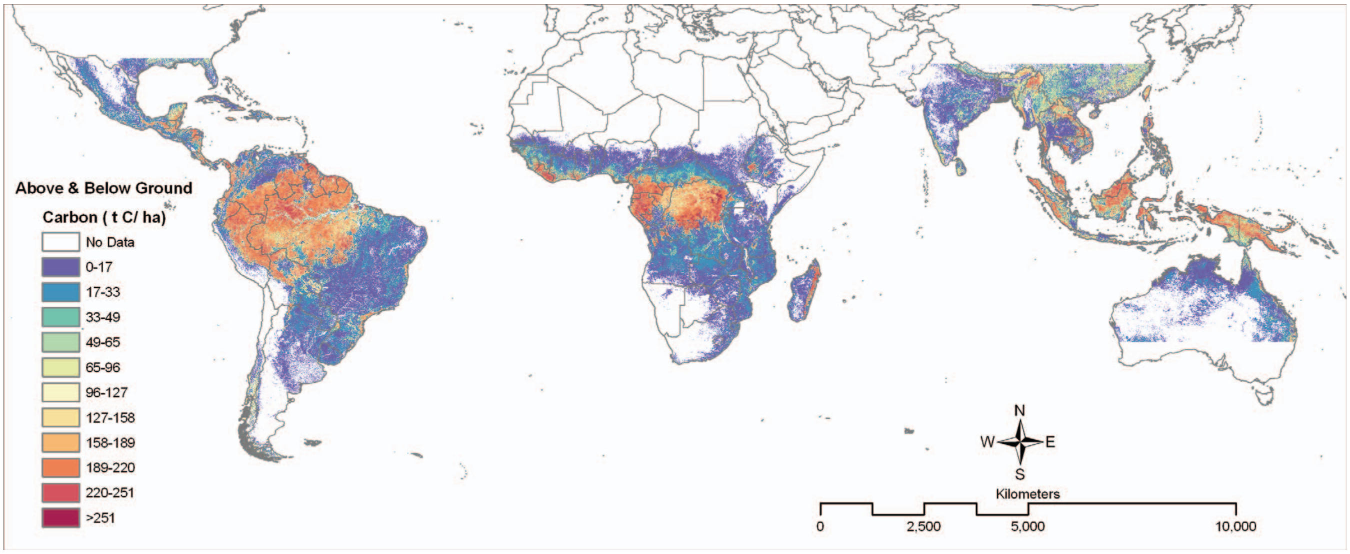

Figure 1. Global distribution of tropical forest aboveground carbon stock at 1 km spatial resolution.

The spatial extrapolation of aboveground biomass distribution to a 1-km resolution map was performed using a combination of the maximum entropy (Maxent) model .and a decision rule classification approach (Saatchi et al., 2007). We combined biomass values derived from inventory plots and height data into eleven biomass classes, ran the Maxent model to estimate likelihood probability density function (PDF) for each biomass class, and developed a decision rule approach that automatically chooses PDF thresholds that represent 80% prediction accuracy. An aboveground biomass map was produced for each continent separately following similar steps (Fig. 1). The maps were evaluated by using cross validation with approximately 50% of the ground and lidar biomass data resulting to an overall accuracy of 76% (LA: 81%, AF: 86%, SA:69%).

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