Monitoring Biomass in the Tanzanian Miombo Woodlands Using Satellite Imagery

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The purpose of this study was to find out if biomass can be effectively monitored using satellite imagery to facilitate the involvement of small-scale farmers in the carbon trade. Observing vegetation cover and growth across many small parcels of land, some less than a hectare, on the ground is prohibitively costly so a remote monitoring system might make it possible to work with individual farmers and provide them with incentives to preserve standing forests. Deforestation accounts for 20% of global carbon dioxide emissions annually. It makes soil more prone to erosion and can lead to desertification. This study focused on the miombo woodlands around Mbola, Tanzania, a Millennium Village site. The woodlands are being destroyed for fuel wood in the tobacco industry, livestock grazing, and expansion of agricultural land.

Carbon composes roughly half of the biomass of a tree so the amount of carbon being stored in an area can be evaluated by measuring the total biomass. Researchers went to Mbola in March 2009 to collect data about the diversity and size of trees in the region. They performed a stratified random sample of trees and recorded their species and diameter-at-breast-height (DBH). We used species specific allometric equations to relate DBH to total biomass when available; otherwise we relied on general Tanzanian miombo equations. The average biomass density for the plots that were located in forest stands was 46.4 Mt/ha, consistent with values for other miombo woodlands from the literature.

We also tried to develop a classification system to group pixels into different land types using satellite imagery collected by the Landsat and Quickbird spacecrafts but this was not achieved. The Landsat images are available for the past 25 years, recording the changes in vegetation over time with a resolution of 30x30 m, and the Quickbird images have superior resolution (15x15 m). The images are split into 6 spectral bands that can be layered in different combinations to reveal characteristics of the land. It was difficult to distinguish between trees, fields, and other types of vegetation in the false-color composite image using the blue band as blue, red band as red, and near-IR band as green. Similarly, trying to find a Normalized Difference Vegetation Index (NDVI) threshold above which there were only trees was also problematic. Continued experimentation with different band combinations could yield a more reliable method.