DISTRIBUTION OF ABOVEGROUND BIOMASS IN AFRICAN WOODLAND SAVANNAS

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Abstract

The African woody savannas form a semicircle around the western central rainforest areas, bordered by the desert zones to the north and south, covering an area of more 800 million hectares across a variety of soil conditions with rainfall ranging from 200-1800 mm. These ecosystems, which are characterized by the co-dominance of trees and grasses, play a major role in the global carbon cycle because of increasing land use activities (use of wood and cultivation), and a wide range of disturbance regimes (fire and herbivory). They also have the potential to be directly impacted by climate change and variability due to their dependence on water and nutrients. To quantify and monitor the contribution of these ecosystems to the global carbon cycle, there is a need to develop better, and repeatable, estimates of the continental extent and distribution of woody biomass in African savannas.

In this paper, we present a novel approach to combine limited field measurements of aboveground biomass from a network of vegetation plots across Africa and remote sensing data to map the biomass distribution of woodlands. We used the maximum entropy approach in conjunction with the plot data to estimate a probability space for biomass classes ranging from 10-150 Mg/ha. These probability spaces have been constructed from a suite of measurements of vegetation structure, seasonality, leaf area, and moisture at 1 km resolution provided by spatial metrics derived from MODIS LAI and EVI monthly data, monthly QSCAT scatterometer imagery at H and V polarizations, and SRTM elevation data. A classified map was produced by thresholding the probability spaces for each biomass range at their highest accuracy tests. This map represented the potential biomass of the Africa woodlands for the period of the mid-decade (circa 2005) and was validated using a bootstrapping approach and spatial statistical techniques with the plot data. We examined the spatial distribution of biomass by intersecting the results with the rainfall climatology derived from 10 years of TRMM data and a continental soil map. The results provided insight into the role of climate and soil in controlling woodland carbon stocks.

Keywords: Africa, Biomass, Carbon, Savanna, Woodland, Forest, MODIS, QSCAT, TRMM, Maximum Entropy

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