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IMPROVED ESTIMATION OF ABOVE GROUND BIOMASS IN SUDANIAN WOODLANDS USING MULTI-TEMPORAL LANDSAT-8 IMAGERY AND TEXTURE METRICS

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ABSTRACT:

Growing pressures on African woodlands from climate change and land use increases the need for detailed and up-to-date tree-cover maps to support research and natural resource management. Medium resolution satellite imagery is attractive in this context due to low costs and wide spatial coverage. However, high landscape heterogeneity and an open canopy often causes mixed pixel problems in this environment, which results in relatively weak relationships between the spectral response (e.g., vegetation indices) and tree-cover attributes, including the above ground biomass (AGB). Improved AGB estimates may be possible if additional tree-cover characteristics, such as vegetation seasonality and canopy texture, are taken into account in predictive modeling.

This study investigates the potential of Landsat-8 for AGB estimation in a woodland/agroforestry area in central Burkina Faso. Three different sets of image derived predictor variables were combined and evaluated, including i) spectral variables (e.g., bands and indices), ii) texture metrics, and iii) seasonality parameters. Texture metrics were calculated from grey level co-occurrence matrices, whereas seasonality parameters (e.g., start and end of growing season) were derived from a one year time-series using temporal trajectory analysis. Regression tree ensembles (Random Forest) were used to model the relationship between AGB data from 78 field plots and the three sets of predictor variables. The *in situ* AGB data were calculated through species specific allometric equations.

Results from cross validation indicate that the three sets of predictor variables has relatively low potential for AGB estimation when used in isolation (spectral information performed best with r^2_{adj}=0.50 and RMSE=25 t/ha). Overall performance improved considerably when spectral, texture metrics and seasonality parameters were used in combination: the best model explained 73% of the variability in the field data (r^2_{adj}=0.73 and RMSE=17 t/ha). This study suggests that multi-temporal Landsat-8 imagery and regression tree ensembles are suitable for estimating AGB in African woodlands.