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Assessment of seasonal features based on Landsat time series for tree crown cover mapping in Burkina Faso

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Tree crown cover (CC) is an important vegetation attribute for land cover characterization, and for mapping and monitoring forest cover. Free data from Landsat and Sentinel-2 allow construction of fine resolution satellite image time series and extraction of seasonal features for predicting vegetation attributes. In the savannas, surface reflectance vary distinctively according to the rainy and dry seasons, and seasonal features are useful information for CC mapping. However, it is unclear if it is better to use spectral bands or vegetation indices (VI) for computation of seasonal features, and how feasible different VI are for CC prediction in the savanna woodlands and agroforestry parklands of West Africa. In this study, the objective was to compare seasonal features based on spectral bands and VI for CC mapping in southern Burkina Faso. A total of 35 Landsat images from November 2013 to October 2014 were processed. Seasonal features were computed using a harmonic model with three parameters (mean, amplitude and phase), and spectral bands, normalized difference vegetation index (NDVI), green normalized difference vegetation index (GNDVI), normalized difference water index (NDWI), tasseled cap (TC) indices (brightness, greenness, wetness) as input data. The seasonal features were employed to predict field estimated CC (n = 160) using Random Forest algorithm. The most accurate results were achieved when using seasonal features based on TC indices (R^2: 0.65; RMSE: 10.7%) and spectral bands (R^2: 0.64; RMSE: 10.8%). GNDVI performed better than NDVI or NDWI, and NDWI resulted in the poorest results (R^2: 0.56; RMSE: 11.9%). The results indicate that spectral features should be carefully selected for CC prediction as shown by relatively poor performance of commonly used NDVI. The seasonal features based on three TC indices and all the spectral bands provided superior accuracy in comparison to single VI. The method presented in this study provides a feasible method to map CC based on seasonal features with possibility to integrate medium resolution satellite observation from several sensors (e.g. Landsat and Sentinel-2) in the future.