The 37th International Symposium on Remote Sensing of Environment
Earth Observation for Development and Adaptation to a Changing World
Tshwane, South Africa, 8 - 12 May 2017

Mapping fractional woody cover in semi-arid savannahs: data mining bulk-processed Landsat and ALOS PALSAR data

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Effective monitoring of the Earth's ecosystems requires the availability of methods for quantifying the structural composition and cover of vegetation. This is especially important in heterogeneous environments, such as semi-arid savannahs, which are naturally comprised of a dynamic mix of tree, shrub, and grass components. The fractional coverage of woody vegetation is a key ecosystem attribute in savannahs, particularly given current concerns over the invasion of grasslands by shrub species (i.e. shrub encroachment), or the over-exploitation of woody biomass for fuelwood. Remote sensing has a clear role to play in monitoring semi-arid environments, and in recent years, the number of both spacebourne sensors and imagery acquired has increased dramatically allowing for data mining-based investigations. In this study, we investigated the potential of optical and radar-based remote sensing data for mapping woody canopy cover in sub-Saharan Africa savannahs, using the Limpopo Province of South Africa as a case study. A total of 92 variables were compiled, consisting of 90 Landsat spectral variability metrics and two PALSAR backscatter layers. These variables were used as input to a Random Forest-based work-flow that tested the impact of sensor combinations, seasonality, and scale on resulting predictions. Results showed that models at a 120 m scale produced considerably more accurate results than finer resolutions. PALSAR variables were consistently the most important predictors, but alone produced poor modelling accuracies. Using Landsat metrics, dry season data was the best predictor followed by annual, with wet season the worst performer. The bulk processing of the Landsat archive to generate spectral variability metrics provides a rapid method for mapping savannah woody cover. The potential for multi-sensor applications, incorporating ALOS PALSAR data, also offers improvements to monitoring efforts.