

RANDOM FOREST CLASSIFICATION FOR MONITORING BUSH ENCROACHMENT IN A SOUTH-AFRICAN SAVANNAH WITH LANDSAT AND ANCILLARY DATA

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ABSTRACT:

African savannahs are undergoing land degradation processes that include the reduction of vegetation cover as a whole or simply the change in species composition via the expansion of woody perennials over grasses. The monitoring of the bush encroachment dynamic process remains a considerable challenge, despite the increasing attention the topic has received in the last two decades. Using Earth observation (EO) data is seen as the only feasible solution to the obstacles posed by the extent the process often covers in conjunction with the accessibility and infrastructure hurdles that African regions commonly face.

Here, we focus in an area in the Northwest Province of South Africa, where we apply a methodological framework for the monitoring of bush encroachment. We employ multi-temporal, dry-season Landsat TM and ETM+ (SLC-on) from 1989 until 2009 and ancillary data in a GIS environment. The classification is performed using Random Forests (RF). We map six land cover types based on the South African national land cover mapping nomenclature and include 13 parameters in the RF model: six Landsat image bands, rainfall, NDVI, Moisture Stress Index, Modified Soil-adjusted Vegetation Index, elevation, aspect and slope. The mean decrease in accuracy and mean decrease in Gini results show that annual rainfall and elevation are the most important variables for the RF classifier, whereas, slope and aspect are insignificant. The 2009 classification is validated using 0.5m resolution aerial photography yielding high accuracy figures and low omission and commission errors for all classes. Overall, the results show that there is a steady and rapid increase in the area covered by shrubs and bushes (from ~58% in 1989 to ~67% in 2009) and a subsequent decrease in the area covered by graminoids (from ~41% to ~33%). Our approach is a step towards a rigorous and effective savannah degradation assessment.

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