

Improving estimates of woody shrub expansion using Landsat time-series trajectories

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ABSTRACT:

The encroachment and proliferation of woody shrub species into grassland or savannah ecosystems has important carbon and ecosystem-service provision consequences. It is therefore imperative that savannahs and grasslands are effectively monitored to prevent continued degradation. To date there have been relatively few attempts to map and monitor shrub encroachment on a large scale. Consequently, the timing and magnitude of shrub encroachment in many regions is poorly understood. Here, we aim to demonstrate a methodology for the monitoring of shrub encroachment using a Landsat-based time-series approach. We test this method in a well-studied locality, the Kruger National Park (NP), South Africa, to ensure a reliable validation is undertaken. It is envisaged that the procedure outlined here may be extended as a component of a wider land degradation and desertification monitoring system across the region.

We generated annual composite mosaics of the entire Kruger NP using Landsat data corrected for atmospheric effects and clouds. A time-series of annual imageries was available from 1989-2014, selecting images obtained from July-October in order to capture the dry season. Colour orthophotos with a 0.5m pixel resolution were used to train a predictive Random Forest model for shrub cover, which was implemented on the annual time-series. These annual layers were then analysed using a time-series segmentation algorithm: Landsat-based Detection of Trends In Disturbance and Recovery (LandTrendr).

Results showed that shrub encroachment was most evident on the southern section of the park, with the southern granite biome being the most affected. Comparatively, the northern section was shown to have little-to-no shrub cover expansion. The shrub-cover appears to expand the quickest in periods of high rainfall that follow years with below average rainfall. There is clear spatial autocorrelation of shrub encroachment, which is in agreement with studies that propose a positive feedback between continued expansion of woody shrub species.

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