# Applied Vegetation Science

# What lies beneath: detecting sub-canopy changes in savanna woodlands using a three-dimensional classification method

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## Abstract

Question: Increasing population pressure, socio-economic development and associated natural resource use in savannas are resulting in large-scale land cover changes, which can be mapped using remote sensing. Is a three-dimensional (3D) woody vegetation structural classification applied to LiDAR (Light Detection and Ranging) data better than a 2D analysis to investigate change in fine-scale woody vegetation structure over 2 yrs in a protected area (PA) and a communal rangeland (CR)? Location: BushbuckridgeMunicipality and Sabi Sand Wildtuin, NE South Africa. Methods: Airborne LiDAR data were collected over 3 300 ha in April 2008 and 2010. Individual tree canopies were identified using object-based image analysis and classified into four height classes: 1–3, 3–6, 6–10 and >10 m. Four structural metrics were calculated for 0.25-ha grid cells: canopy cover, number of canopy layers present, cohesion and number of height classes present. The relationship between top-of-canopy cover and sub-canopy cover was investigated using regression. Gains, losses and persistence (GLP) of cover at each height class and the four structural metrics were calculated. GLP of clusters of each structural metric (calculated using LISA – Local Indicators of Spatial Association – statistics) were used to assess the changes in clusters of eachmetric over time. Results: Top-of-canopy cover was not a good predictor of sub-canopy cover. The number of canopy layers present and cohesion showed gains and losseswith persistence in canopy cover over time, necessitating the use of a 3D classification to detect fine-scale changes, especially in structurally heterogeneous savannas. Trees >3 min height showed recruitment and gains up to 2.2 times higher in the CR where they are likely to be protected for cultural reasons, but losses of up to 3.2-foldmore in the PA, possibly due to treefall caused by elephant and/or fire. Conclusion: Land use has affected sub-canopy structure in the adjacent sites, with the low intensity use CR showing higher structural diversity. A 3D classification approach was successful in detecting fine-scale, short-term changes between land uses, and can thus be used as amonitoring tool for savannawoody vegetation structure.