



Spatial-temporal dynamics of savanna ecosystems as a life support system to wildlife and livestock production in and around Kruger National Park

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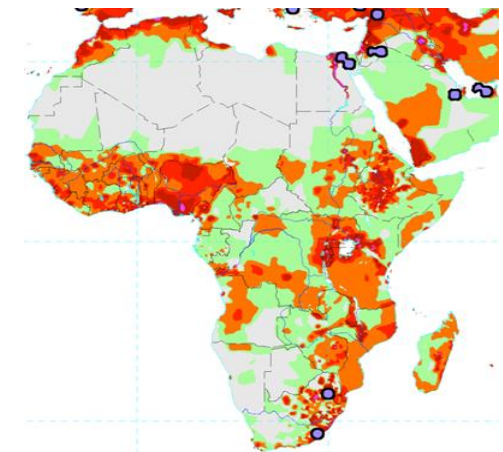
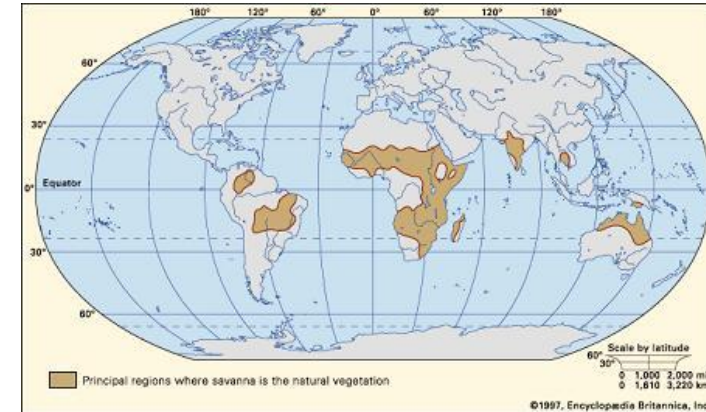
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- Continuous C4 grass layer and discontinuous tree layer
- Forested lands > 10% cover (FAO 1998)
- Spatially and vertically very heterogeneous
- Controlled regionally by rainfall/geology and locally by disturbances (fire, grazing, mega-herbivores) (Sankaran et al 2005)

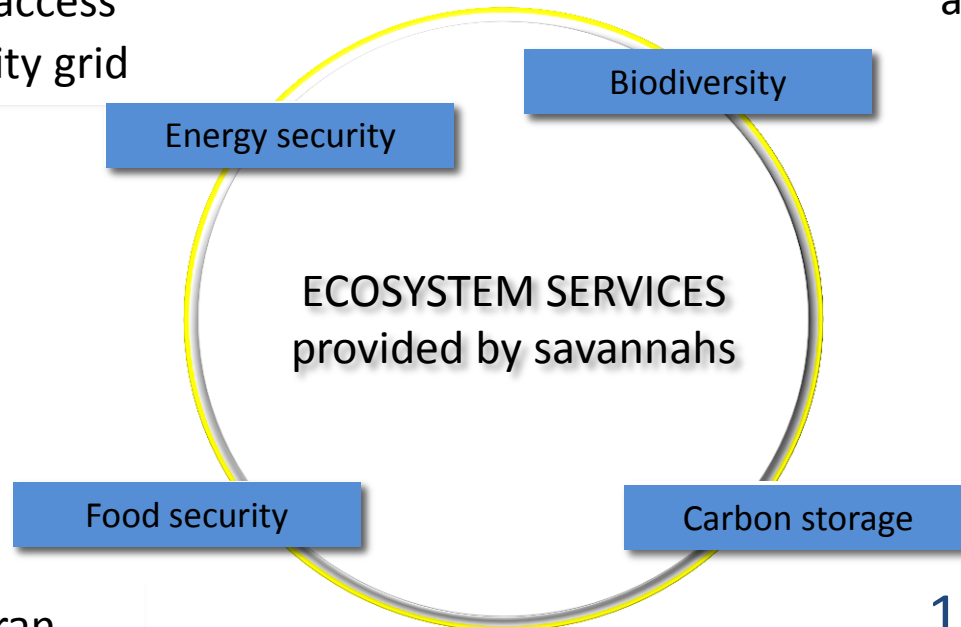


- Globally 33 M km² (20%) (Scholes and 1997)
- Largest biome in Africa (>50%)
 - ✓ E.g. Forests covers 37.1 % of SA
 - 42 m ha (35%) of savannahs
 - 1.2 m ha (1.1%) of exotic plantations
 - 0.5 m ha (0.5%) of indigenous forests
- Resource use & economy
 - ✓ 2010: 414 million people (48%) live in extreme poverty in Sub-Saharan Africa (<1.25US\$/day)
 - ✓ Highest density of rural people in savannahs
 - ✓ Timber, grazing, fuelwood, medicinal plants



African population density

70% of Sub-Saharan population depends on woody biomass for household energy needs
1 of 5 people has access to a national electricity grid



3.4 & 5.5% of GDP of eastern and southern Africa come from tourism
320 million US\$ the annual biodiversity value of savannahs in South Africa (wild products)

25% of Sub-Saharan African rural households hold cattle or small ruminants
Grazing systems support the livelihood of 350 million people in Africa

15% of the global carbon is stored in savannahs
30% of the total global terrestrial net primary productivity originates from savannahs



Climate change
+1.4-1.6 deg. by 2050
Potential ET to increase 5-10%
Carbon sequestration scheme



Overgrazing and use
25% of land in South Africa
is severely degraded



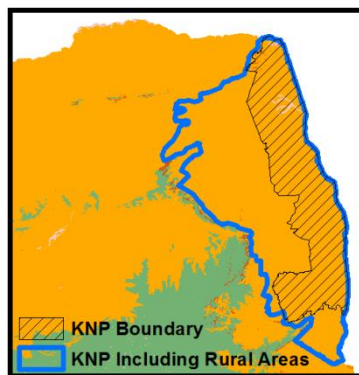
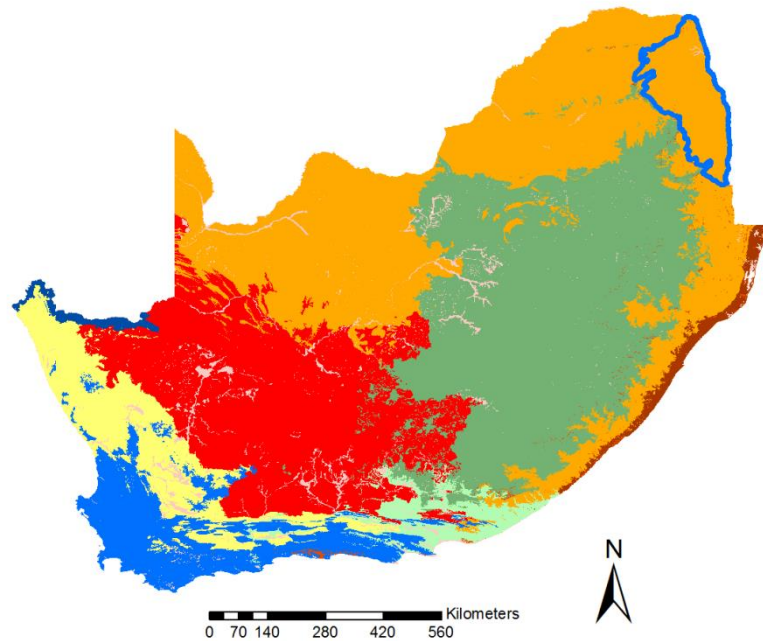
Bush encroachment
26 millions ha in Namibia
60% decline in livestock



Land conversion
3% per year in Africa



Biome Map of South Africa, Including Lesotho and Swaziland



- KNP Including Rural Areas
- Vegetation Map**
- Albany Thicket Biome
- Azonal Vegetation
- Desert Biome
- Forests
- Fynbos Biome
- Grassland Biome
- Indian Ocean Coastal Belt
- Nama-Karoo Biome
- Savanna Biome
- Succulent Karoo Biome

- Located in the Savanna biome
- Bordered by an ever changing land use in the western part - 90% of rural community relying on fuelwood collection.
- Livestock production is the mainstay for rural livelihood
- Famous for Ecotourism – contributes to SA economy
- Key Threats: bush encroachment, overgrazing, elephant impact and poaching of large mammals, land use change in the buffers, invasive species
- **Important to understand the condition, extent and quality of the vegetation as the main provisioning ecosystem service**

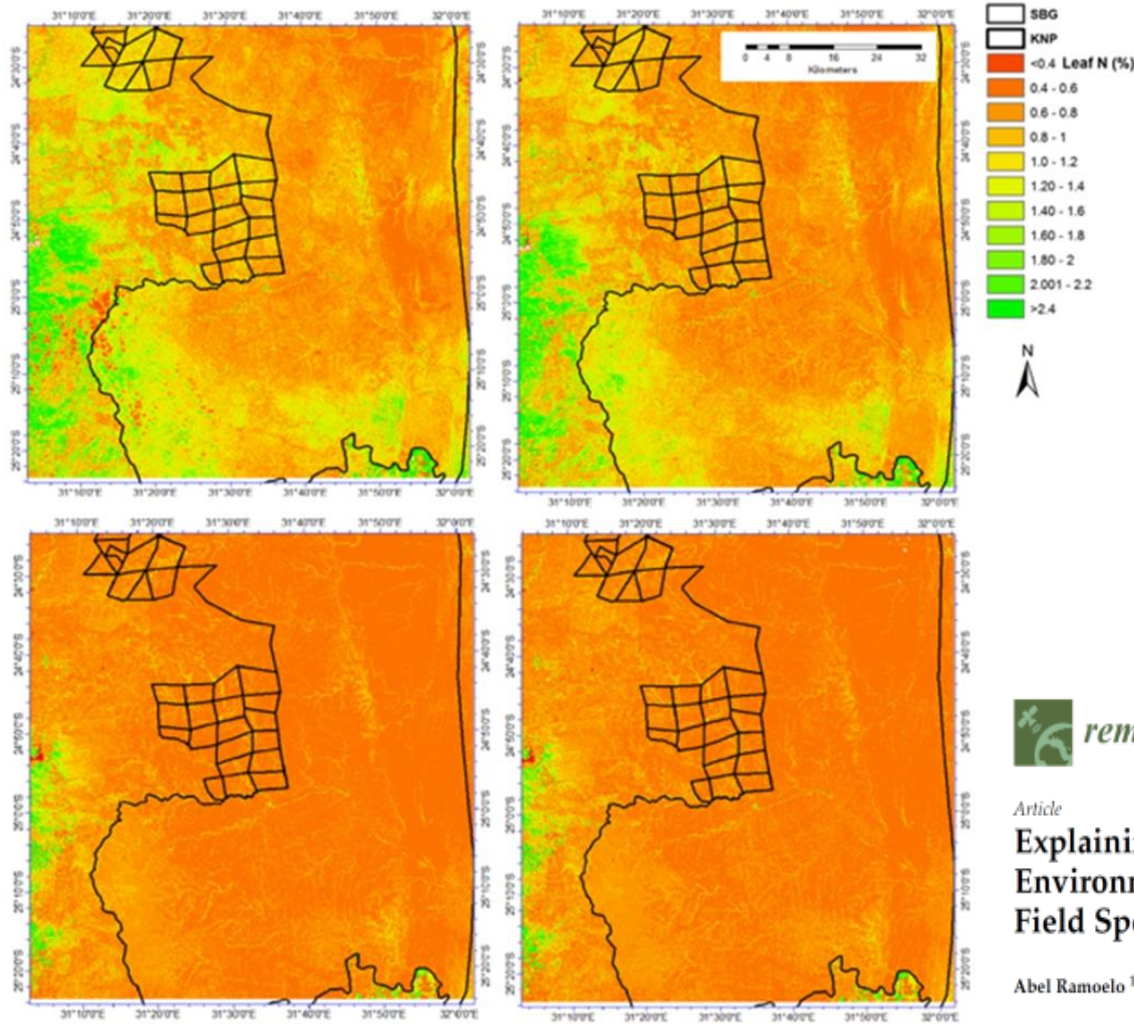


- To investigate and map spatio-temporal dynamics in three essential biodiversity variables in and around Kruger National Park
 - including rangeland condition (the quantity/quality of grass),
 - tree-cover percentage and
 - Land surface phenology.





Leaf nitrogen concentrations (%) – 2010 - Rapidye



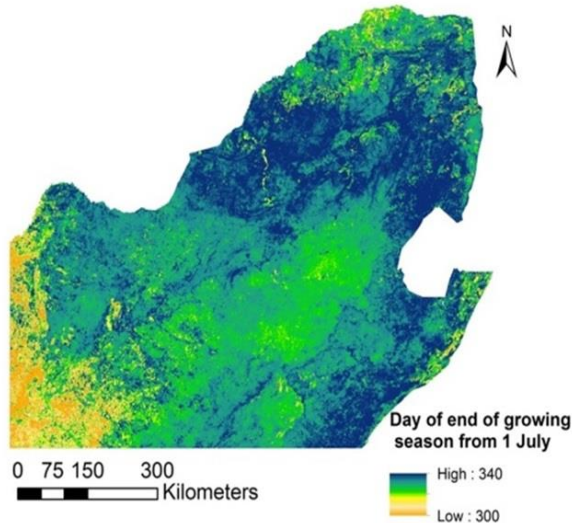
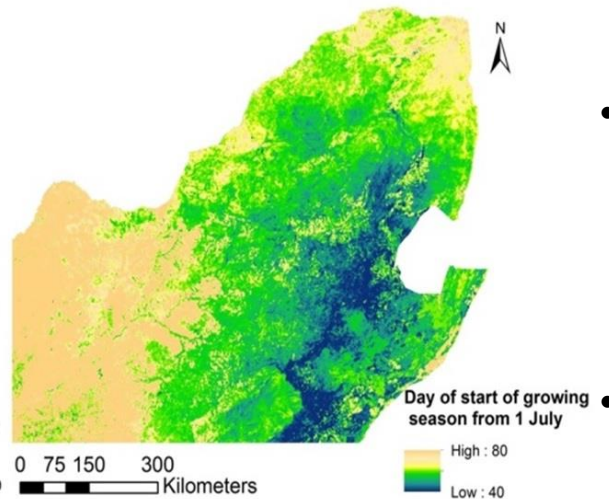
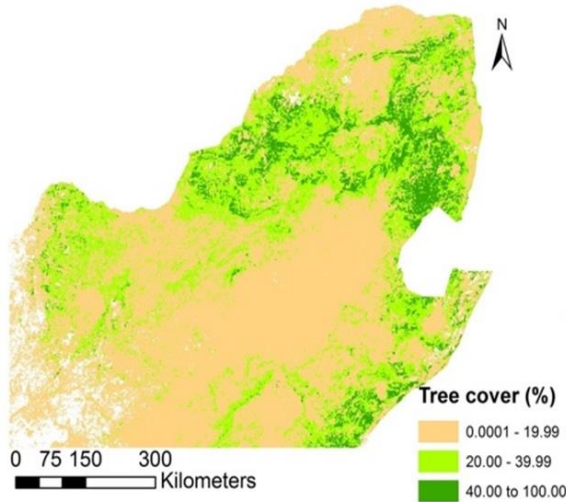
Article

Explaining Leaf Nitrogen Distribution in a Semi-Arid Environment Predicted on Sentinel-2 Imagery Using a Field Spectroscopy Derived Model

Abel Ramoelo ^{1,2,*} and Moses Azong Cho ^{1,3}



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- Tree cover (%), day corresponding to start of growing season and day of end of growing season.
- Trees dominated areas show longer growing season as compared to grassy areas.



Article

Response of Land Surface Phenology to Variation in Tree Cover during Green-Up and Senescence Periods in the Semi-Arid Savanna of Southern Africa

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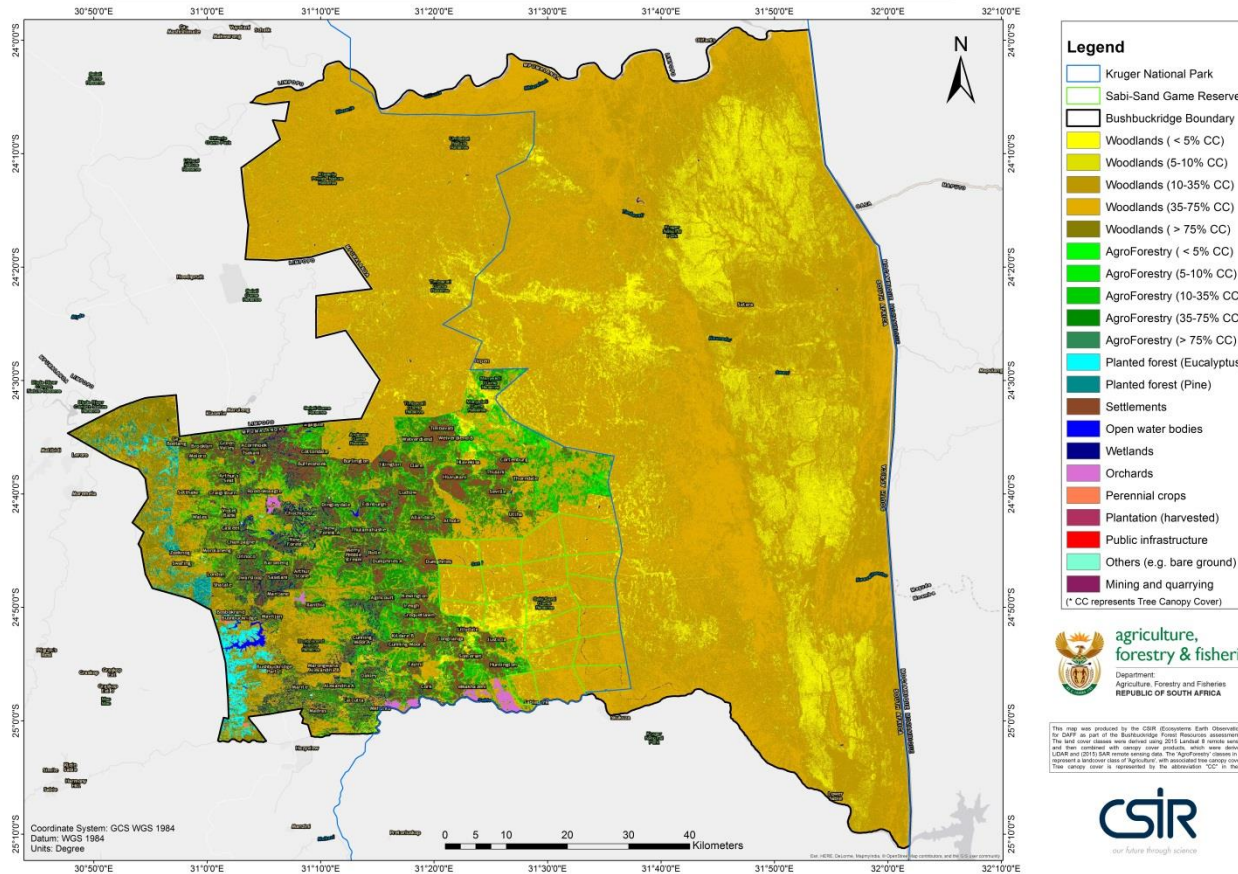
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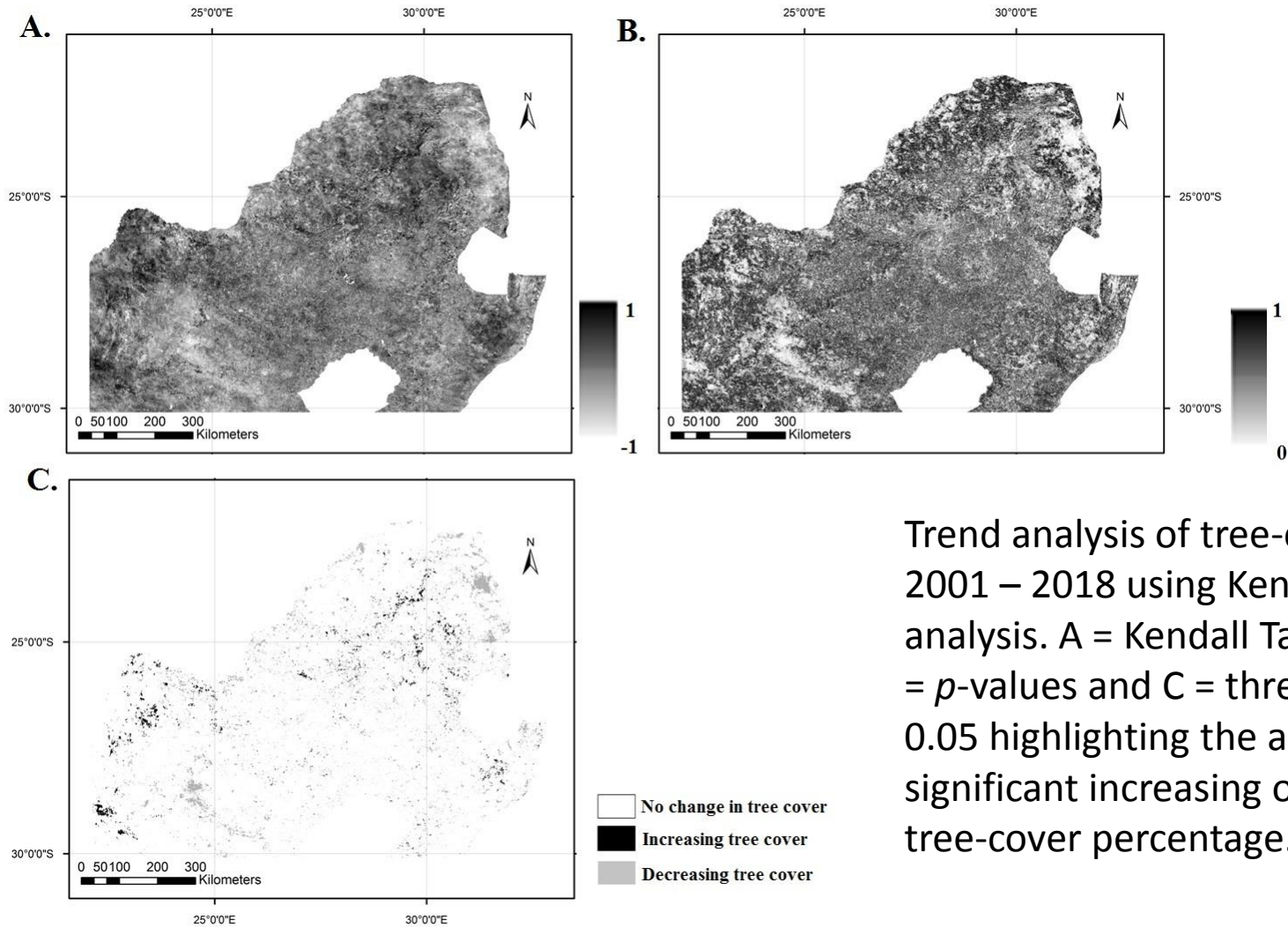
Bushbuckridge Forest Cover and Land Use Classes (2015 Assessment)



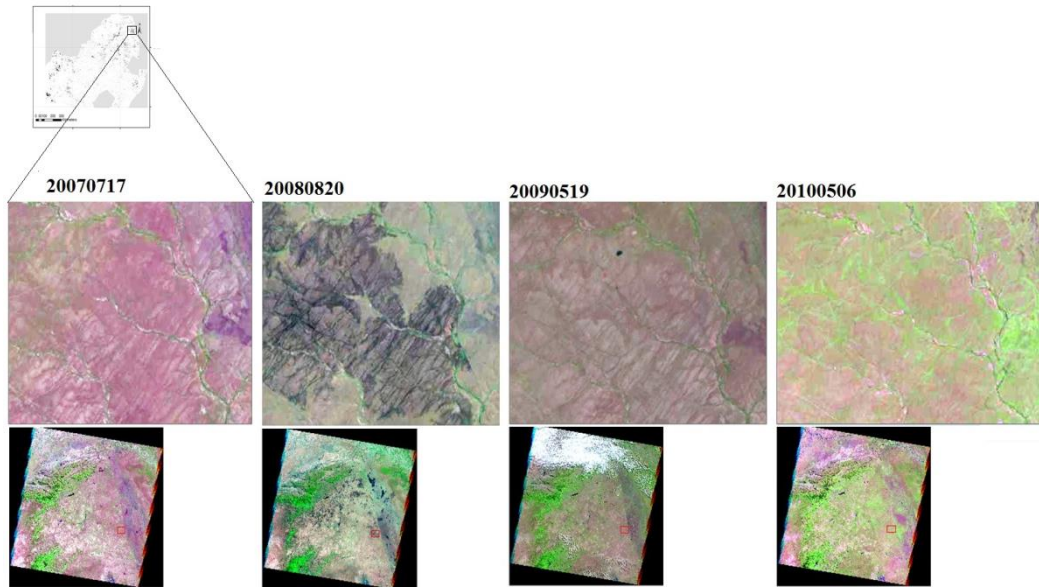
Tree cover (%), derived from synthetic aperture radar (SAR) data, used in combination with land use map derived from the Landsat imagery to assess spatial variability of tree cover in the Kruger National Park region and surrounding communities



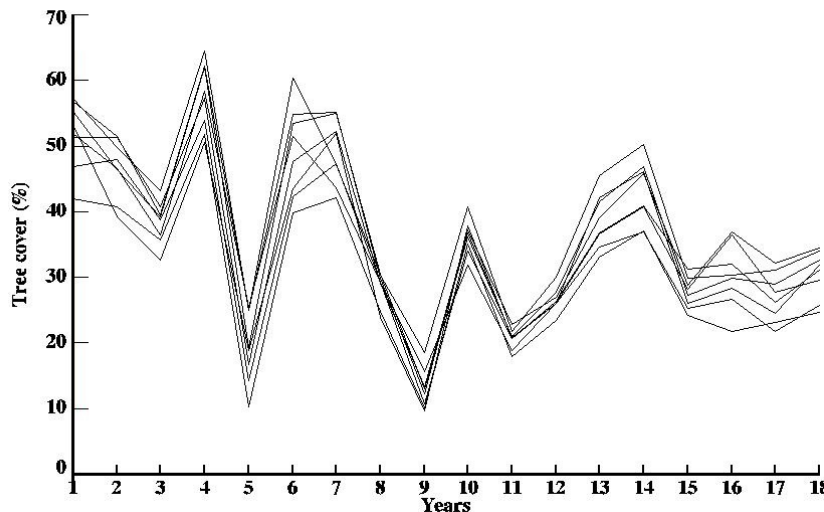
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Trend analysis of tree-cover change 2001 – 2018 using Kendall correlation analysis. A = Kendall Tau coefficient, B = p -values and C = threshold of $p < 0.05$ highlighting the areas of significant increasing or decreasing tree-cover percentage.



- Landsat TM5 images of 2007, 2008, 2009 and 2010 of an area in the Kruger National Park that showed significant decreasing trend in tree-cover between 2001 and 2018. A fire scar can be observed in 2008.
- Tree-cover profiles of an area in the Kruger National Park that showed significant decreasing trend in tree-cover between 2001 and 2018. The area was burnt in the winter of 2008.





- Leaf N, a key nutrient in the savanna can be mapped using Sentinel-2 images
- When calibrated with LiDAR derived tree-cover data, Synthetic Aperture RADAR data could be useful in producing accurate maps of tree-cover data.
- The study on the response of land surface phenology on variation in tree cover during green-up and senescence periods in the semi-arid savanna of Southern Africa reveals that rainfall is the predominant factor that explains the inter-annual variability of the day corresponding to the start of the growing season for areas dominated by grasses
- Tree cover is the predominant factor that explains the variability in the day corresponding to end of the growing season. In fact, the length of the growing season increases with increasing tree cover
- Maps of the Essential biodiversity variables can be used to determine the threshold of potential concern (TPC) of biophysical conditions of the Kruger National Park.

