

Land Cover Change and Savanna Heterogeneity in Kruger National Park, South Africa.

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Outline

- Kruger National Park.
- Questions addressed.
- Data.
- Problems/Challenges.
- Methodology.
- Preliminary Results.



Location





Kruger National Park

- First Wildlife reserve of South Africa established in 1926, KNP extends over 20,000 sq. kms.
- Home to over 150 species of mammals, over 2000 species of plants and over 500 species of birds.
- Part of the UNESCO "Kruger to Canyon" biosphere reserve.



- Savanna environment largest biome in southern Africa (UNEP/GRID, 2004).
- Climate alternation of a warm dry season with a hot wet season - mild dry winters and hot wet summers .
- Six to eight months of rainfall followed by a period of drought and fire.
- Importance of soil moisture availability in determining the growth of trees and grasses.



KNP as seen by Landast





Questions

- What are the land cover classes identifiable at the resolution of Landsat (ETM) in KNP ?
 What is the land cover change in KNP from 1999 to 2002 ?
- Has land cover change influenced savanna heterogeneity ?



DataLandsat ETM+ images.





Problems/Challenges

- Image
 - Gradual variation of pixel values.
 - Spectral overlap between classes.
 - Cloud cover.
- Study Area
 - Located along political boundary.
 - Disturbances:
 - Fire.
 - Flooding.



Methodology

- DN to Radiance to TOA Reflectance.
- Spectral Indices:
 - Soil Adjusted Vegetation Index (SAVI);
 - Normalised Burn Ratio (NBR);
 - Normalised Differential Soil Index (NDSI).
- Unsupervised Classification.
- Supervised Classification.



Spectral Indices

SAVI = [(NIR - R) / (NIR+R+L)] * (1+L) where L=0.5 for intermediate vegetation.
NBR = (NIR-SWIR) / (NIR+SWIR).
NDSI = (SWIR-NIR) / (SWIR+NIR).

 Index values range from -1 to +1 which is re-scaled back to the 0-255 range.



October 1999



SAVI

NBR

NDSI



August 2000



SAVI

NBR

NDSI



September 2001



SAVI

NBR





July 2002



SAVI

NBR





Land Cover

- Clusters Unsupervised Classification.
 - 20 initial clusters refined to 8 final ones.
- Land Cover Classes Supervised Classification
 - Spectral signatures for 8 cover classes: Bare soil, Grassland, Shrubland 1 and 2, Active Vegetation, Water Body, Burn Scar and Regrowth.
 - Maximum Likelihood classifier.

Land Cover - Oct 1999

ETM full scene

Active Dense Vegetation

Kruger subset





10	Class Names	
1	Bare Soi	
	Grassland	
	Regrowth	
	Shrubland 1	
	Shrubland 2	
1	Active Dense Vegetation	
	Burn Scar	
1	Water	

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Land Cover - Sep 2000



ETM full scene

Kruger subset



Land Cover - Sep 2001



ETM full scene

Active Dense Vegetation Mature Dense Vegetation

Water Body

Kruger subset





Color	Class Names			
	Grassland			
	Regrowth			
	Shrubland 1			
	Bare Soil			
	Active Dense Vegetation			
	Burn Scar			
	Shrubland 2			
	Water Body			

Land Cover - Jul 2002

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Water Body

ETM full scene

Mature Dense Vegetation

Water Body

Kruger subset







Change Detection

- SAVI Differencing.
 - Change: 0.5 Standard Deviation from Mean.

SAVI	Mean	0.5 * Standard
Differences		Deviation
1999 - 2000	2.26	10.55
2000 - 2001	19.50	9.75
2001 - 2002	21.35	10.67



SAVI	Mean	Standard
		Deviation
October 1999	132.53	19.56
August 2000	134.76	20.12
September 2001	140.88	20.62
July 2002	136.03	21.04

SAVI	Mean	0.5 * Standard
Differences	人。但是	Deviation
1999 - 2000	-3.63	16.65
2000 - 2001	-15.21	16.86
2001 - 2002	6.24	19



Change: 1999 - 2000



Less than 0.5 std dev More than 0.5 std dev



Change: 2000 - 2001



Less than 0.5 std dev More than 0.5 std dev



Change: 2001 - 2002



Less than 0.5 std dev More than 0.5 std dev



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Texture









Conclusions

- Land cover change does take place.
- A gradual process with the exception of disturbance triggered changes - fire and flood.
- Heterogeneity changes as "seen" through texture images are scarce.
- Need for area-specific ground-truthing.