Mapping decadal land cover changes in northern Namibia using the Landsat satellite archive (1975-2015)

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Outline

Introduction

- Study site and vegetation cover change in N Namibia
- Landsat satellite data
- Objectives
 - Assess the extent of vegetation cover change
 - i.e. deforestation, vegetation gain
- Method
 - Vegetation change mapping using the whole Landsat satellite archive
 - Landsat satellite image analysis tools
- Initial results
 - Multi-temporal land cover class maps of vegetation cover change
 - Data on extent of loss and gain of forest cover
- Next steps
 - Mapping fractional/percentage vegetation cover

Study site



northern Namibia

- Vegetation change
 - Human impact
 - Reduced savannah woodland
 - Expansion of arable land
 - Increased grazing

- Expand on change work
 - Erkkilä et al. (2001)
 - Röder et al. (2014)



Landsat data

- Landsat archive
 - Freely available, USGS
 - Local, regional, and global-scale analysis
 - Vegetation change i.e. deforestation
 - Numerous applications
 - 1972 Present
 - Repetitive, synoptic
 - High resolution (30x30m pixel)



Objective

- Map changes in land cover in N Namibia
 - Between 1975 and 2014 at decadal intervals
 - Emphasis on woodland/savannah cover change
 - Arable/agricultural land expansion



Methods

- Post-Classification method
 - Land cover is assigned to a class
 - Easily measure extent (i.e. ha, km2)
 - Transitions between classes



Landsat archive analysis

- Whole archive available for analysis:
 - Google's earth engine
 - Select the best quality pixels for given period
 - Create a new best image
 - Classify new images into land cover classes for change analysis



https://earthengine.google.com

Mean Summer Image

August 2004

Initial results

Decadal land cover class extents (%)



	Landcover	1975	1985	1995	2004	2014		
1	Water	0.31	0.44	0.05	1.07	0.31		
2	Claypan	1.56	2.01	2.22	1.57	0.46		
3	Agriculture	7.55	7.10	10.08	11.47	11.54		
4	Sand	0.30	0.17	0.20	0.34	0.54		
5	Woodland	90.04	89.16	86.51	83.41	85.77		
6	Wetland	0.24	0.82	0.65	0.72	0.23		
7	Urban	0.00	0.30	0.30	1.42	1.14		

Initial results



Landcover	Location	1975	1984	1994	2004	2014
Woodland	Caprivi	92.06	85.55	92.40	79.61	80.56
Woodland	Kavango	94.15	92.96	96.08	94.83	95.04
Woodland	Ohangwena	76.33	69.16	75.22	67.85	66.75
Woodland	Oshikoto	87.08	79.04	78.32	81.78	71.50

Results and discussion





Results and discussion

Area of Woodland change (%) per distance zone



5 km distance zone

	Variable	Date	r	Date.1	r.1	Date.2	r.2	Date.3	r.3
1	Minor towns	1975-1984	-0.77	1984-1994	-0.92	1994-2004	-0.75	2004-2014	-0.93
2	Rivers	1975-1984	-0.65	1984-1994	-0.70	1994-2004	-0.65	2004-2014	-0.67
3	Roads	1975-1984	-0.68	1984-1995	-0.75	1994-2004	-0.65	2004-2014	-0.83
4	Major towns	1975-1985	-0.26	1984-1994	0.57	1994-2005	-0.74	2004-2015	0.39

Results and discussion

- Land cover change between 1975-2014
 - Over all decrease in woodland
 - Increase in arable land
 - Variable rates of change
 - Losses and gains
 - Small-scale conversion



Limitations and further work

- Limiations of post-classification method
 - Difficult to produce consistent results
 - Subjectivity introduced operator judgements
 - Leads to erros hard to replicate
- Savannahs environments
 - Heterogenous land covers
 - Inter-intro annual variation
 - Shifts fire, rainfall, grazing

Fractional cover

- Quantitative analysis of the percentage cover (0-100%) of live vegetation, dry vegetation and exposed substrate for each satellite pixel
 - ecologically meaningful maps
 - identify % forest cover
 - deforestation



Conclusion

- Decrease in vegetation cover
- Increase in arable land
- Number of limitations with mapping methods
- Especially true for savannahs environments
- Probably resulting in the variable results observed
- Next pat of the study will explore the issue further using Fractional Cover method