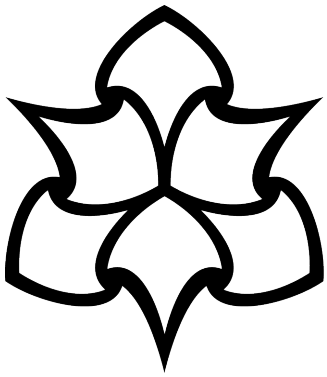


Shrub Encroachment in South African Savannahs: a CO_2 Fertilisation Effect?

Tom Higginbottom & Elias Symeonakis (T.Higginbottom@mmu.ac.uk)
Manchester Metropolitan University, UK

1- Introduction

Increases in woody cover are occurring across all savannah and grassland biomes.

There are three competing hypotheses to explain woody encroachment:

1. **Land Use**: overgrazing and fire suppression, encourage seedling survival,
2. **Rainfall Variation**: increases in rainfall/ variability favour woody cover at grassland expense
3. **Carbon fertilisation**: atmospheric Carbon increases helps shrubs through improved Water Use Efficiency

2- Aim

Determine the relative contribution of natural and anthropogenic factors on woody encroachment likelihood.

3- Study Area: Limpopo Province, South Africa

4- Methods

1. Two **Landsat-derived fractional woody cover** maps, 5-year epochs using all observations as spectral metrics, **1984-198 2008-2012**
2. Percentage change in woody cover calculated
3. Series of explanatory variables collated
4. **Generalised Additive Model (GAM)** to model variable contributions.

Explanatory Variables:

Rainfall factors- derived from TAMSAT:

1-3: Mean Annual Precipitation + SD + CV
4- MAP trend 1983-2010,
5-7: Mean wet season precip , + SD + CV
8-9: Mean rainy days, + SD
10-11: Wet season rainy days, + SD
12:- Percent of rainy days in wet season
2-d smoother to account for spatial autocorrelation

Natural Factors:

1: Sand Content
2: Organic Content
3: Soil Class
4: Geology

Human Factors:

1: Land Use Category
2: Fire Frequency

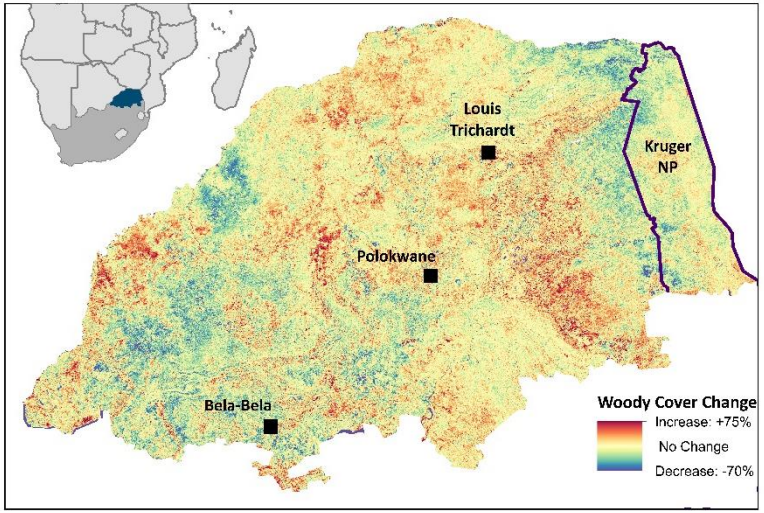
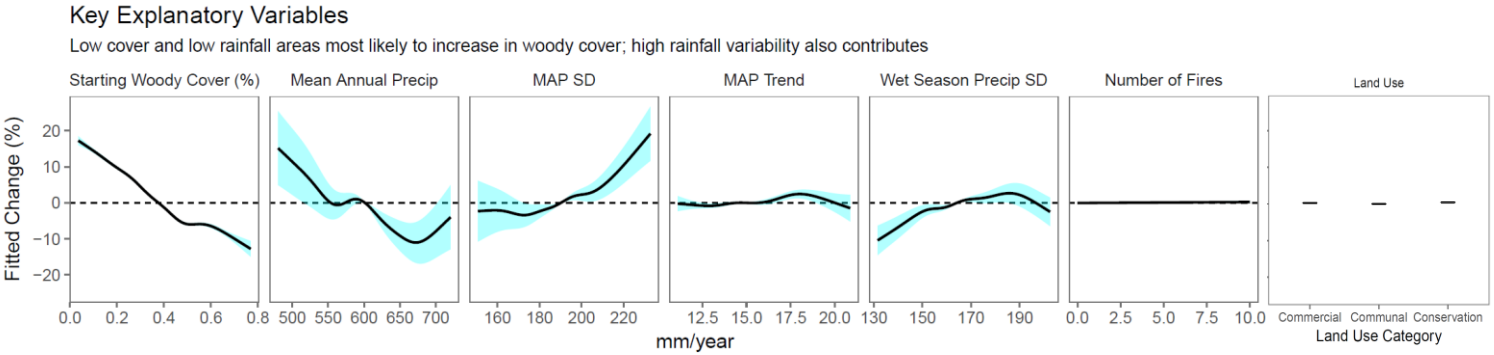


Figure 1: Woody Cover Change (%) 1986-2010

Figure 2: Smooth functions from the GAM



GAM Statistics:

R^2 =~0.4
N= 29964
REML= 1.06×10^5
Scale Est.= 70.4

All variables significant, with **exception** of: fire, land use, and some soil/geology factors

5- Results & Discussion

Carbon Fertilisation

I. Low rainfall & low woody cover savannahs were most prone to woody cover increases

II. This is consistent with a Carbon fertilisation hypothesis, as water use efficiency gain will be most pronounced in water limited systems

Human Factors

I. Fire and land use were insignificant variables

II. May be a data issue, land use processes (e.g. specific actions, stocking rates) potentially more relevant than category

Rainfall Variation

I. Large trends in rainfall have a minor effect

II. High variability increases potential of increases

6- Conclusion

We conclude that woody encroachment in South African savannahs is most likely a response to Carbon fertilisation, with rainfall regime playing a role in susceptibility.

We found land use to be an insignificant factor, although future work is needed to fully confirm this.