LAND TRANSITION AND CLIMATE CHANGE: PATTERNS AND VULNERABILITY OF VEGETATION IN SOUTHERN AFRICA

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1. Abstract

Southern Africa (SA) supports a significant portion of the world's flora biodiversity, but the region has been identified as extremely vulnerable to the predicted changes in the climate. Although many research studies have assessed vegetation degradation in Africa, few studies focused on the South African region. This study seeks to understand vegetation cover change and resilience across SA and explore their association with data on climate and land utilization.

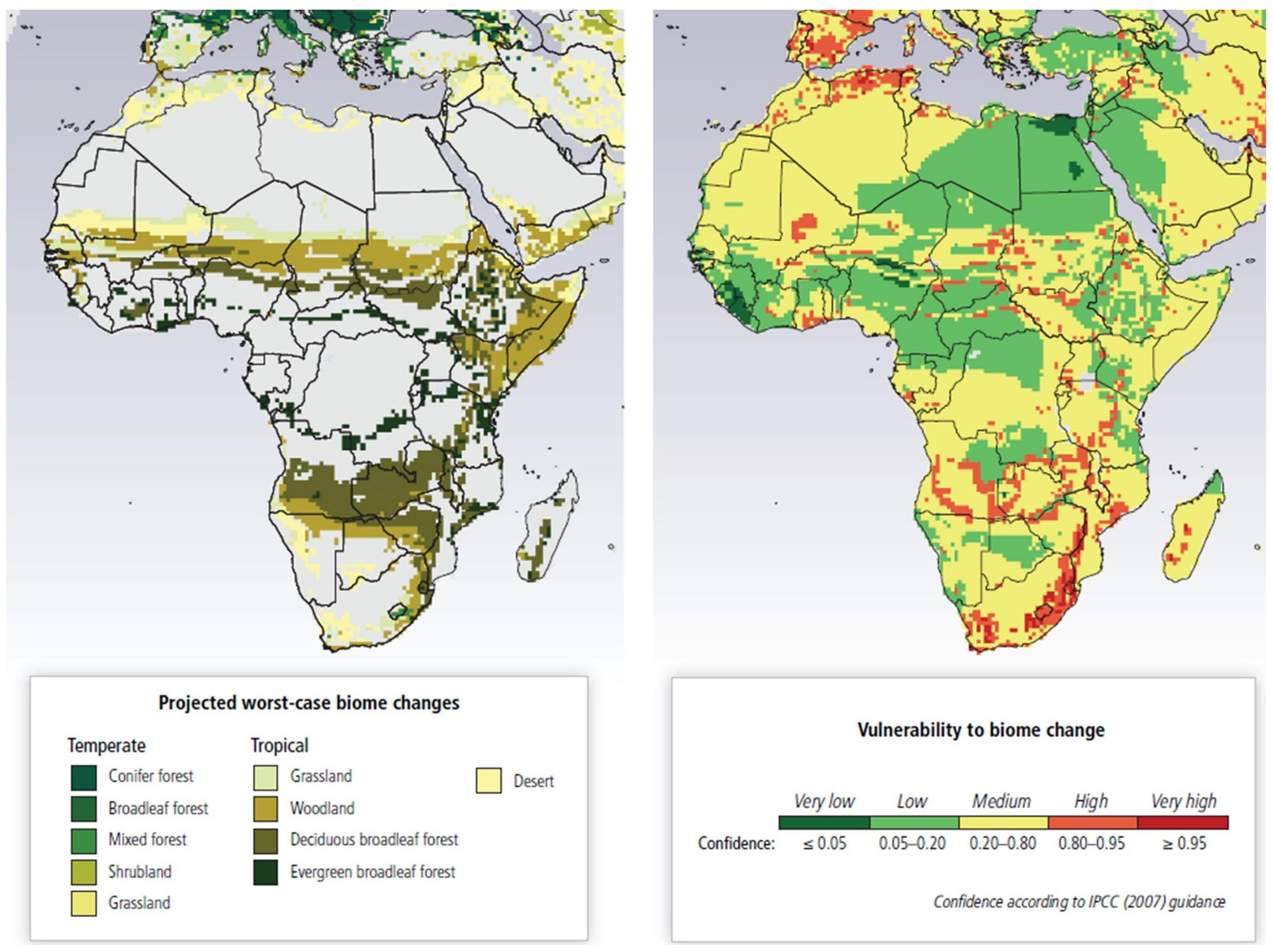
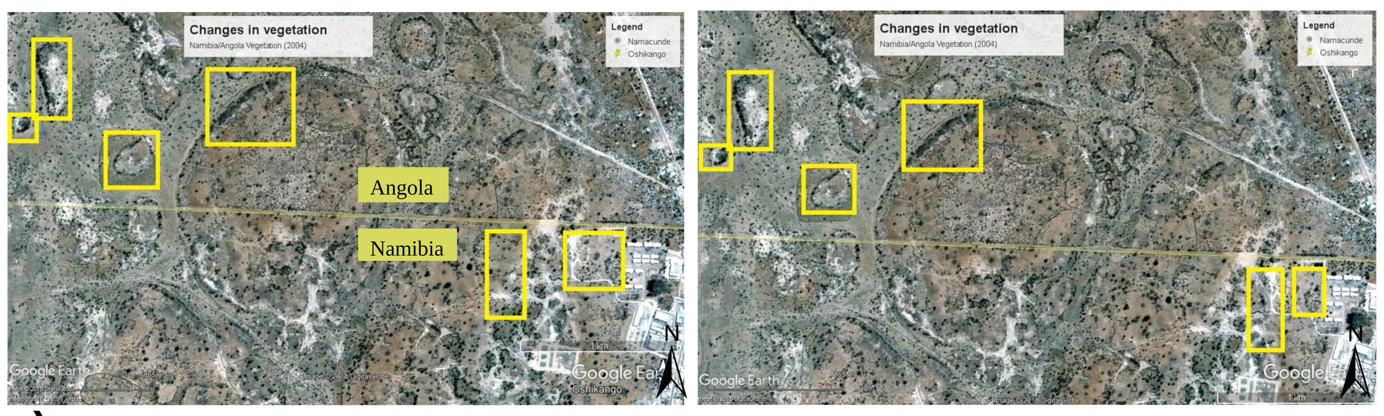


Figure 1 : Shows (a) projected biome change b) vulnerability of ecosystems to biome shifts (2071–2100). Source: IPCC (Niang et al, 2014).

2. Introduction

Vegetation in Southern Africa are under increasing pressure from climate change, variability in climatic conditions and human activities (Niang *et al.*, 2014). The research aims to quantify the spatial and temporal patterns of vegetation dynamics and land cover changes. Ultimately, the study will give insights on the climate and human factors contributing to vegetation change at the regional scale of Southern Africa.



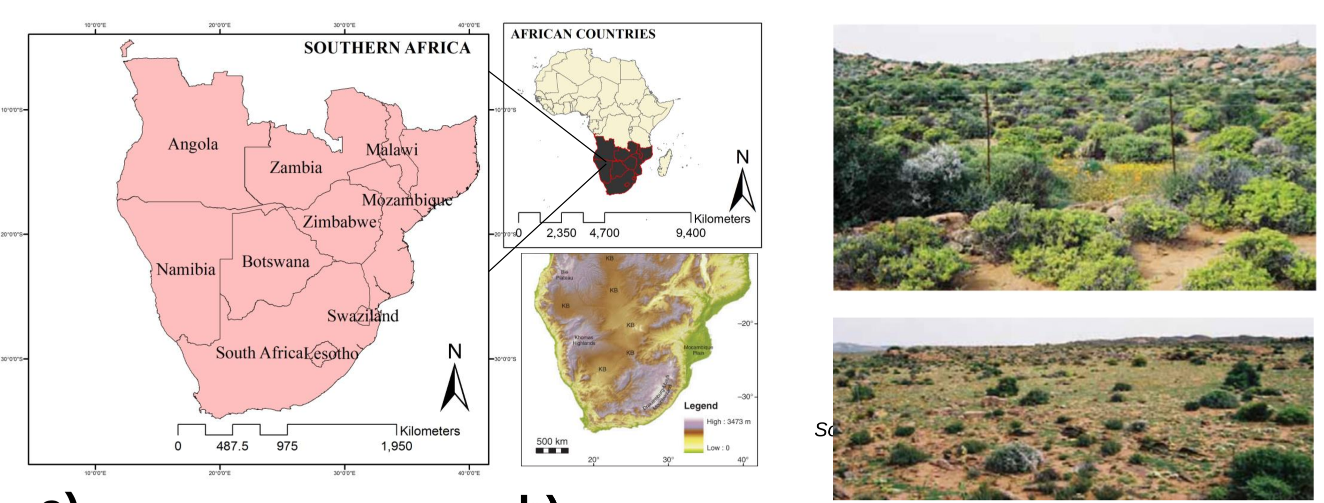
a) b)

Figure 2: Shows vegetation change between a) 2004 and b) 2018 taken in the same month of August.

3. Objectives

- Determine the long-term trends of vegetation change in Southern Africa.
- Explore the relationship between observation of change and climatic, and anthropogenic factors.
- Develop models to inform future scenarios of climate change impacts on vegetation in the region.

4. Study Area



a) b) c) Source: Simon Todd

Figure 3 a): The study area of Southern Africa b) SRTM elevation map c) Paulshoek rangeland (South Africa) in good and severely degraded state.

Rainfall: highly variable, deserts<200mm, and some highland areas >2000 rainfall (O'Brien et al., 2000).

5. Methods

- Google Earth Engine, multi-temporal satellite images.
- Select climatic and human factors and statistical analysis.
- Dynamic global vegetation model.
- Interviews (citizen science) with local people to gain their perceptions of vegetation degradation.

6. Expected Results

- Produce a regional map of long-term vegetation patterns.
- Give insights on the climate and anthropogenic factors contributing to vegetation change.
- Gain understanding on future scenarios of climate change impacts on vegetation in the region.

7. Preliminary Results

7.1 Gauge distribution

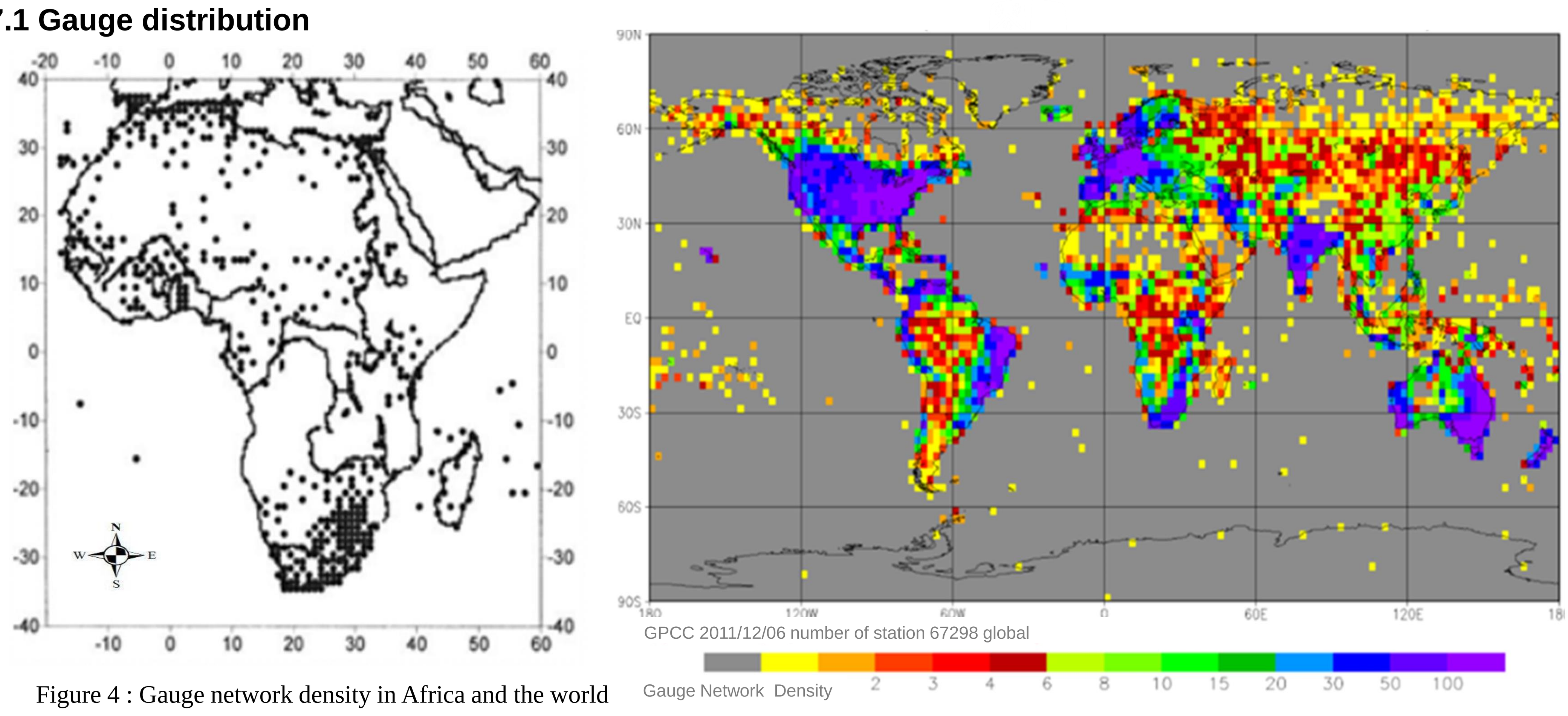


Figure 4 : Gauge network density in Africa and the world

7.2 Rain gauge and satellite-based annual precipitation comparison 1981-2016

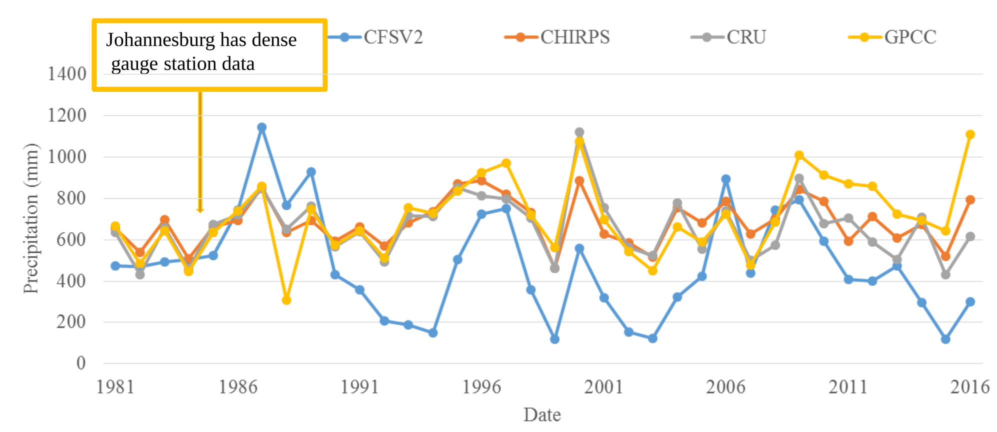


Figure 5: Johannesburg, coordinates[28.29,-26.05], (1981-2016)

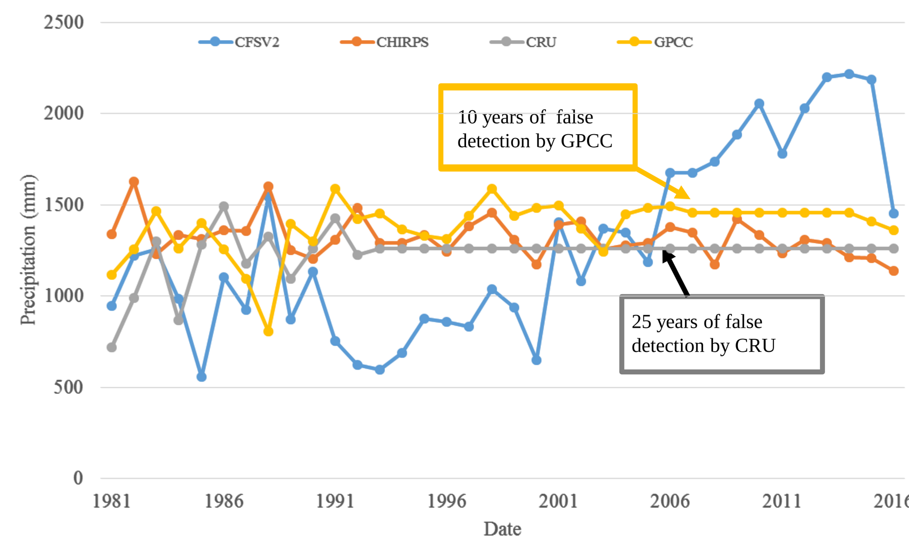


Figure 6 : Angola, coordinates[18.82,-10.29], (1981-2016)

7.3 Vegetation variation in Northern Namibia/Angola

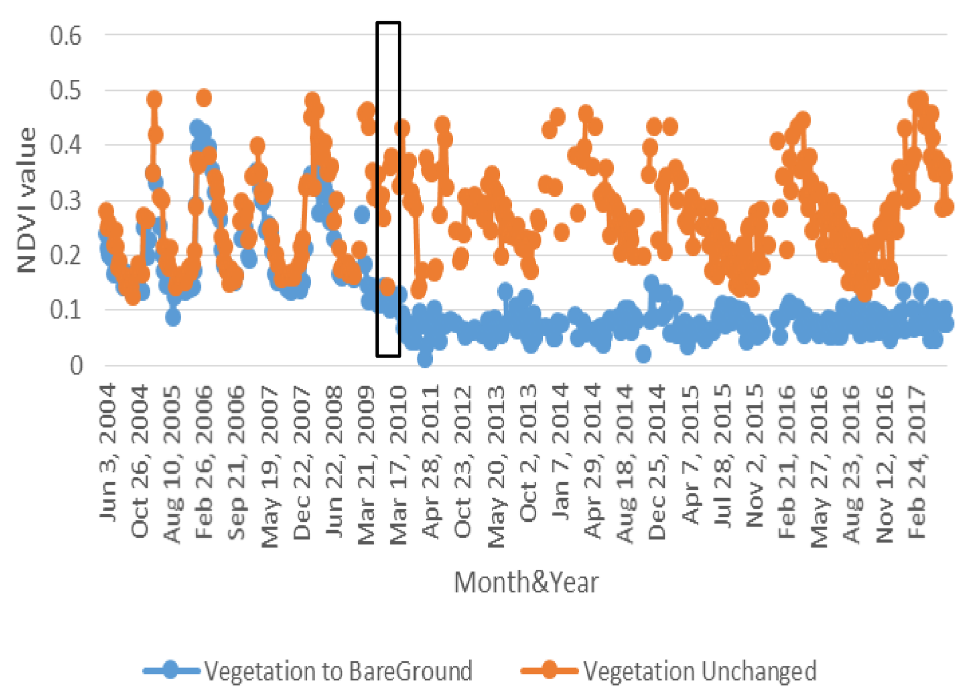


Figure 7: Time series of NDVI data for the selected vegetation

Abbreviation

- **CHIRPS**-Climate Hazards Group InfraRed Precipitation with Station data
- **CFSV2**-NCEP coupled forecast system model v2
- **CRU**-Climatic Research Unit (University of East Anglia)
- **GPCC**-Global Precipitation Climatology Centre.
- **NDVI** - Normalized Difference Vegetation Index

Results Interpretation

- First year PhD student preliminary results/ideas.
- CFSV2 significantly underestimate and overestimate the precipitation in SA.
- Gauge data performed poorly in Angola due to poor gauge network density.
- Google earth Engine platform was used to assess changes in vegetation based on landsat time series, the deviation in NDVI value can be seen in 2010.

8. Conclusion

- The results show GPCC and CRU gauge-based gridded precipitation data could be unreliable in regions of poor station network, especially in African countries where rain gauge network is sparse, leaving large parts of the continent unmonitored. The NDVI results confirm some of the potential vegetation disturbance in Southern Africa.
- Satellite-based climatic data improved with gridded precipitation climatologies, Earth observation data and Google Earth Engine could be efficient in the understanding of vegetation change and their vulnerability at a large spatial scale.

9. References

- Niang, I., Ruppel, O. C., Abdrabo, M. A., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Climate Change 2014: Impacts, Adaptation and Vulnerability - Contributions of the Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change., 1199–1265. doi:10.1017/CBO9781107415386.002
- O'Brien, K., Sygna, L., Næss, L. O., Kingamkono, R., & Hochobeb, B. (2000). Is information enough? User responses to seasonal climate forecasts in southern Africa. CICERO Report.