Modelling above-ground biomass in a semi-arid Mokala national park using earth observation satellite data

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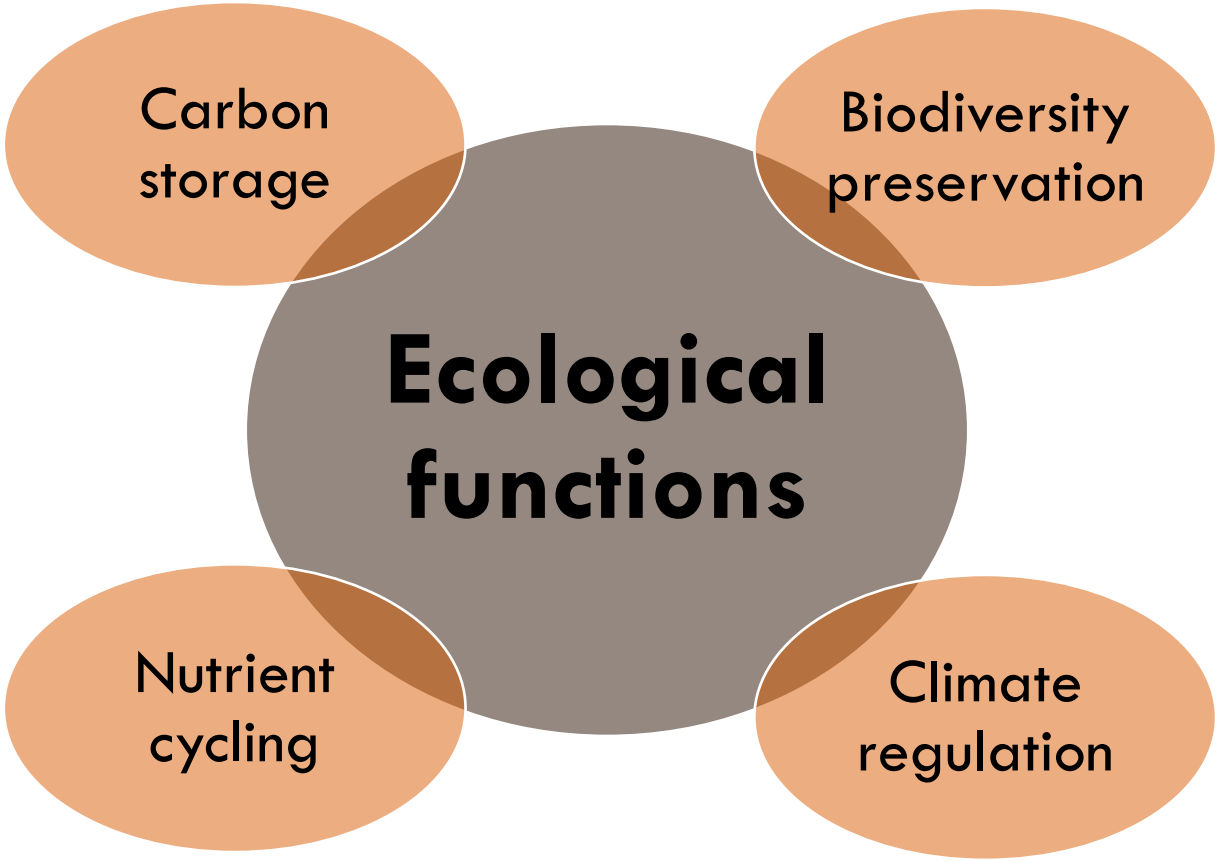
Presentation layout

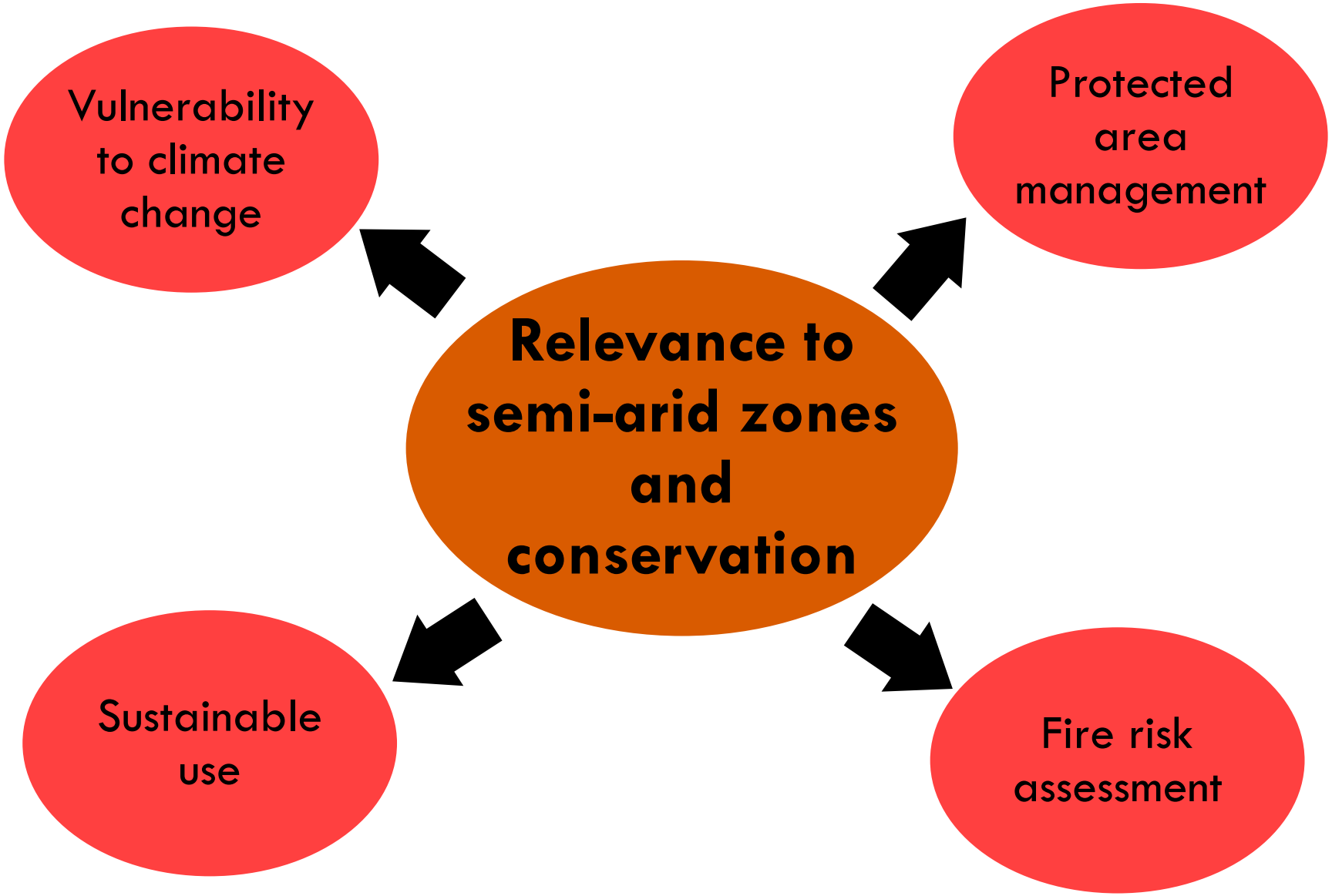
- Introduction
- Methodology
- Results
- Discussion
- Conclusion

Introduction

- Aboveground Biomass (AGB) refers to the total mass of living plant material above the soil surface, including trees, shrubs, and grasses.
- AGB is an essential component of terrestrial ecosystems.
- In semi-arid regions, AGB plays a crucial role in ecosystem balance.

Importance in ecological functions




Vulnerability to climate change
Protected area management
Relevance to semi-arid zones and conservation
Sustainable use
Fire risk assessment

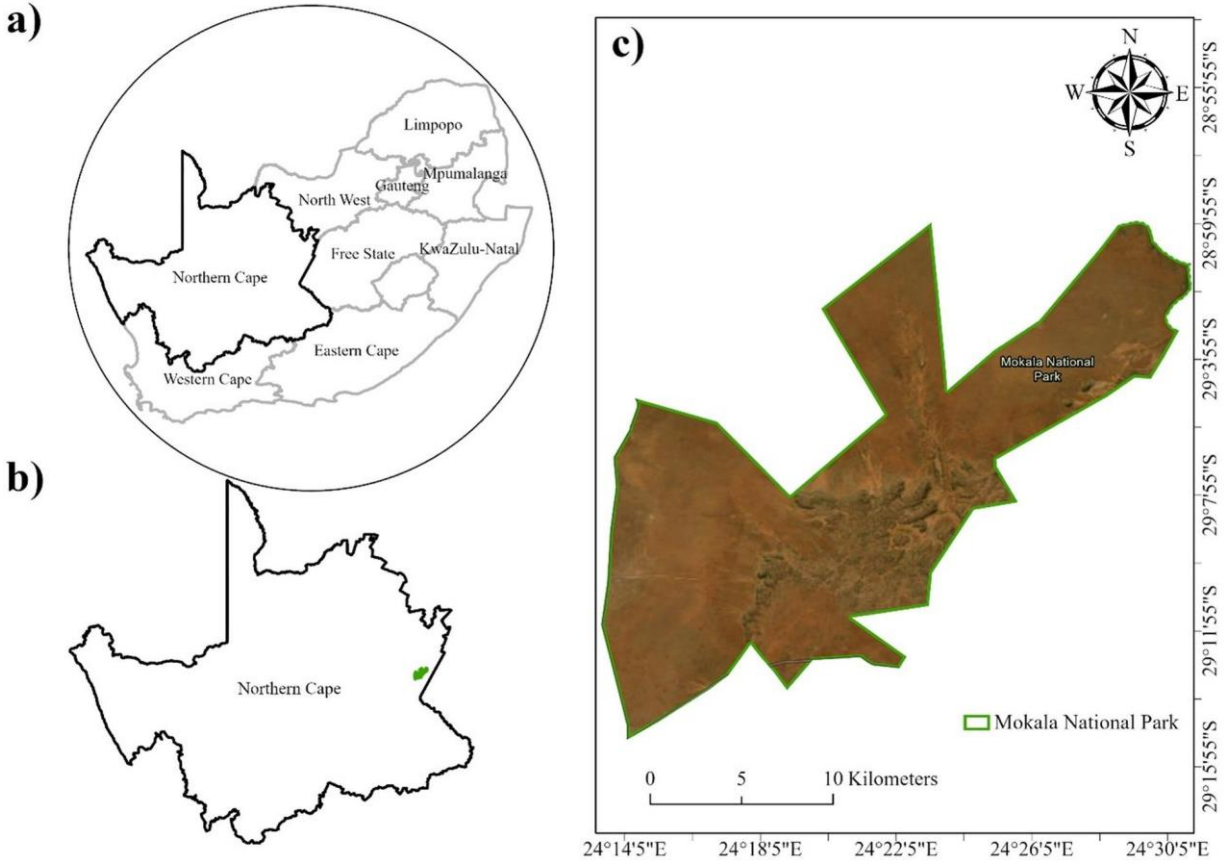
Objectives

- Evaluate regression techniques & the random forest model for AGB prediction

- Identify key vegetation indices improving AGB estimation accuracy

Methodology

- Receives ~300–500 mm annually.
- Hot summers (up to 40°C in January).
- Cold winters, with occasional frost (as low as -5°C in June/July).
- High rainfall variability



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Waterbodies

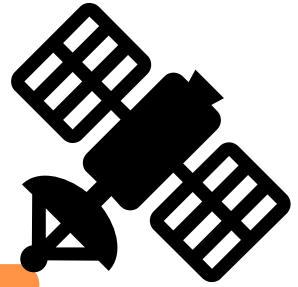
Grasslands

Mokala National Park

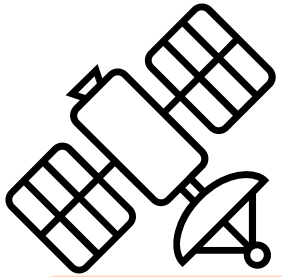
Rocky outcrops and hills

Woodlands

Data sources



- Sentinel-2 (Multispectral)



- Sentinel-1 SAR (VV & VH)

- Ground truth data

- Satellite data preprocessing
- Application of regression techniques and random forest model
- Performance evaluation

- Ten experiments conducted using Sentinel-1 & Sentinel-2
- Background regression techniques applied
- Feature selection
- Polarization effects (VV vs. VH SAR backscatter)

- Linear regression
- Multiple Linear Regression
- Polarization effects

Random forest model

- Ensemble learning method
- Handles complex relationships
- Robust to noise and outliers

Results

- Maximum AGB = 130 Mg/ha.
- Average AGB = 46 Mg/ha.
- Low biomass classification = 81%.

- VV polarization yielded better AGB predictions than VH polarization.
- VH polarization (cross-polarized) is more affected by surface roughness and soil moisture.
- R^2 of 0.91 was obtained showing a strong correlation
- RMSE = 0.23 Mg/ha showing a low error rate

Significant indices

- Green Normalized Difference Vegetation Index (GNDVI)
- Normalized Difference Red Edge (NDRE) 1
- Normalized Difference Vegetation Index (NDVI)

Discussion

- Role of AGB assessment in ecological health monitoring.
- Importance for protected area management.
- Decision-making support for conservation strategies.
- Use of sophisticated models to enhance AGB accuracy.
- Potential applications in other semi-arid protected areas.

- Expanding studies with UAV and LiDAR integration.
- Improving SAR-multispectral fusion techniques.
- Applying deep learning for biomass modeling.

Conclusion

- Successful AGB estimation using satellite data.
- Significant findings on biomass distribution.
- Superior performance of VV polarization in SAR data.
- Importance of vegetation indices in AGB prediction.

References

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Thank You