

Hyperspectral remote sensing of savanna tree species at leaf and crown scales

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Why make maps of tree species in the savanna?



- Biodiversity assessment
- Fire hazard assessment
- Land degradation assessment

Target discrimination with remote sensing

Primary assumption:

- Each target has a unique spectral signature

The Challenge



- High intra-species variability
 - Phenological differences
 - Bushfire
 - Browning effect
- e.g. *Dichrostachys cinerea*

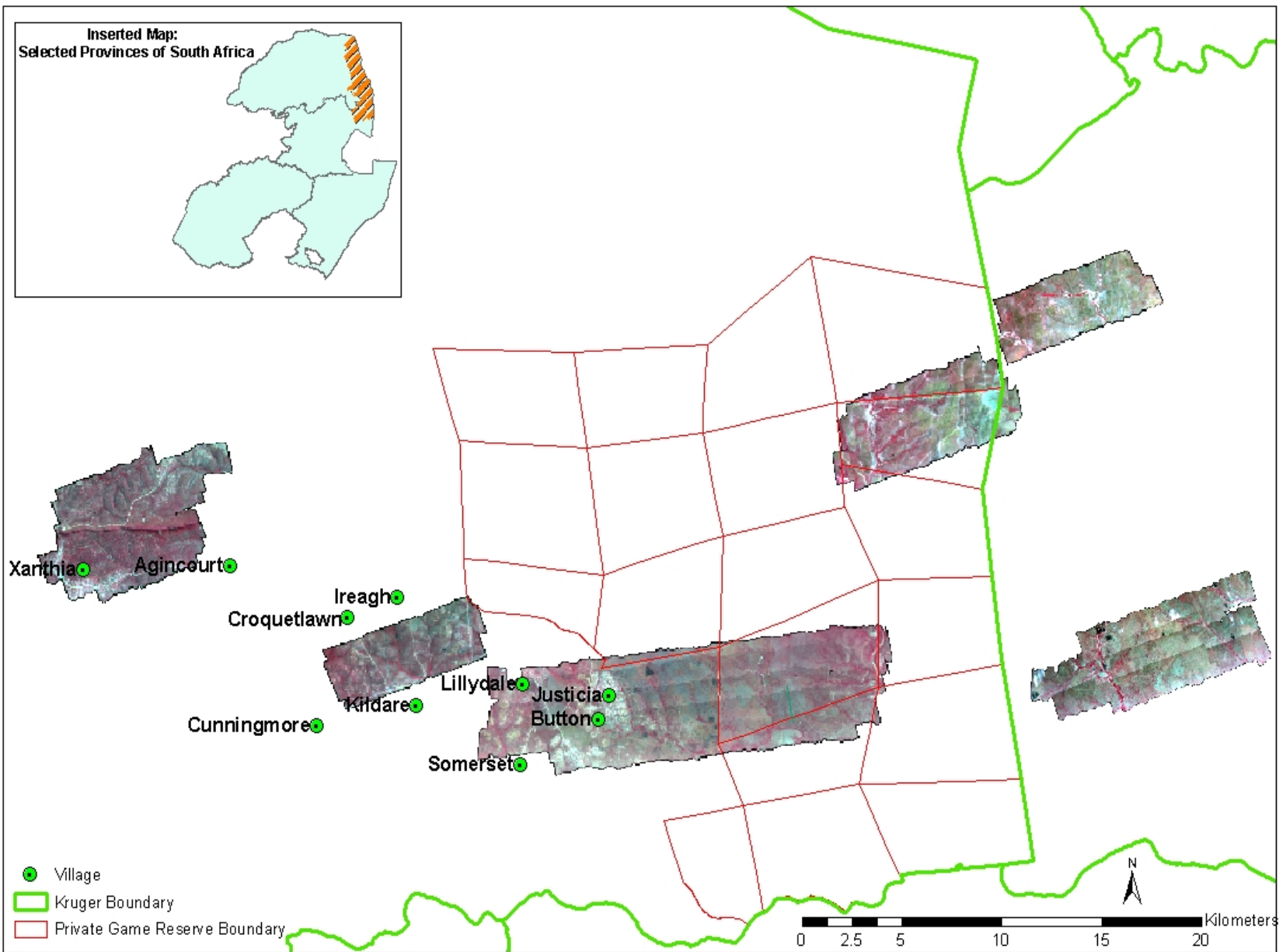
- **Secondary assumption:**
 - Each species has a set of unique IDs

Objective

- Explore the utility of hyperspectral remote sensing for savana species discrimination and mapping

Remote sensing data used for the study

- **Analytical Spectral Device (ASD) spectrometer (FieldSpec3 Pro FR, Inc, USA)**
 - **350-2500 nm range**
- **Carnegie Airborne Observatory**
 - **The Carnegie Airborne Observatory (CAO) consists of an advanced integrated imagery spectroscopy (IS) and LiDAR remote sensing system**
 - **Spectral range: 394.3nm-1044.9nm**



Data analysis

- The spectral data of 7 savanna tree species (*Combretum apiculatum*, *Combretum hereroensis*, *Combretum zeyheri*, *Gymnosporia buxifolia*, *Gymnosporia senegalensis*, *Lonchocarpus capassa* and *Terminalia sericea*) data was split into the training (1/4) and validation (3/4) sets
- The spectral similarity measure - **Spectral angle mapper (SAM)** used to assess the discrimination of 7 tree species at leaf and canopy levels using a proposed multiple endmember approach

Leaf level results

Multiple endmember SAM classifier

	CA	CH	CZ	GB	GS	LC	TS	SUM	USER ACCURACY
CA	5	0	0	0	0	1	0	6	83.3
CH	0	2	1	0	0	0	1	4	50.0
CZ	0	1	3	0	0	1	0	5	60.0
GB	0	0	0	3	0	0	0	3	100.0
GS	0	1	1	0	2	2	0	6	33.3
LC	0	1	0	0	3	1	0	5	20.0
TS	0	0	0	0	0	0	4	4	100.0
SUM	5	5	5	3	5	5	5	33	
PRODUCER ACCURACY	100	40	60	100	40	20	80		
OVERALL ACCURACY		60.6							

Canopy level results

		OBSERVED DATA								
		CA	CH	CZ	GB	GS	LC	TS	SUM	USER ACCURACY
PREDICTED DATA	CA	6	0	0	0	0	0	0	6	100.0
	CH	0	44	0	0	2	3	14	63	69.8
	CZ	0	0	19	0	0	0	0	19	100.0
	GB	0	1	0	1	1	0	4	7	14.3
	GS	0	5	0	1	7	4	3	20	35.0
	LC	2	1	0	0	0	28	13	44	63.6
	TS	1	23	0	1	12	8	103	148	69.6
	SUM	9	74	19	3	22	43	137	307	
PRODUCER ACCURACY	66.7	59.5	100.0	33.3	31.8	65.1	75.2			
OVERALL ACCURACY		67.8								

Conclusions

- The image or crown spectra were better discriminators of the 7 savanna tree species when compared to the leaf spectra, which is good news for air-spaceborne remote sensing of species assemblages.

Thanks



Leaf – conventional SAM classifier

	CA	CH	CZ	GB	GS	LC	TS	SUM	USER ACCURACY
CA	2	0	0	0	0	0	0	2	100.0
CH	1	0	1	0	0	0	0	2	0.0
CZ	0	3	2	0	3	0	0	8	25.0
GB	0	0	0	3	0	1	2	6	50.0
GS	1	1	2	0	1	2	0	7	14.3
LC	1	1	0	0	1	2	1	6	33.3
TS	0	0	0	0	0	0	2	2	100.0
SUM	5	5	5	3	5	5	5	33	
PRODUCER ACCURACY	40	0	40	100	20	40	40		
OVERALL ACCURACY		36.4							

Canopy – conventional SAM classifier

		OBSERVED DATA							SUM	USER ACCURACY
		CA	CH	CZ	GB	GS	LC	TS		
PREDICTED DATA	CA	9	1	0	0	0	6	25	41	22.0
	CH	0	35	0	0	1	4	11	51	68.6
	CZ	0	7	19	0	0	3	2	31	61.3
	GB	0	13	0	2	4	0	27	46	4.3
	GS	0	7	0	1	8	6	7	29	27.6
	LC	0	9	0	0	5	22	38	74	29.7
	TS	0	2	0	0	4	2	27	35	77.1
SUM	9	74	19	3	22	43	137	307		
PRODUCER ACCURACY	100.0	47.3	100.0	66.7	36.4	51.2	19.7			
OVERALL ACCURACY		39.7								

