SASSCAL

MAPPING TYPIFICATION OF MIOMBO USING MEDIUM AND HIGHT RESOLUTION SATELLITE IMAGE (HUAMBO-ANGOLA)

1. **Objetives**
2. *Location*
3. *Metodology*
4. *Results*
5. *Conclusions*

Objetives

- Develop a methodology of typification of Miombo forest based on analysis of satellite images of medium and high resolution
- Elaborate the thematic mapping of typification of the Miombo in the province of Huambo (Angola).

The result of this study will increase the knowledge of Miombo in Angola. The information is very important to obtain a model of management of these forest formations that allows a sustainable use by the local communities

Location

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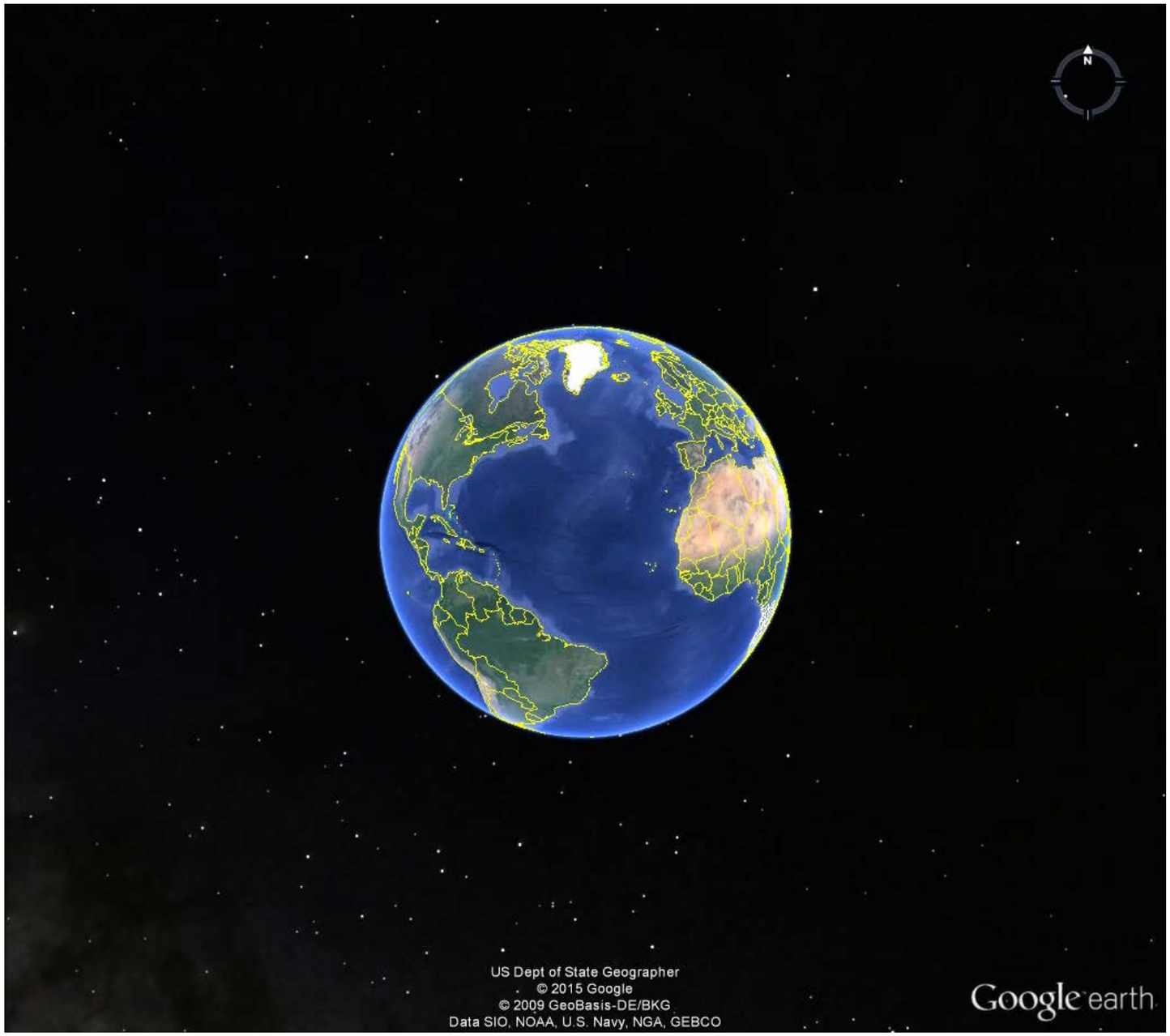

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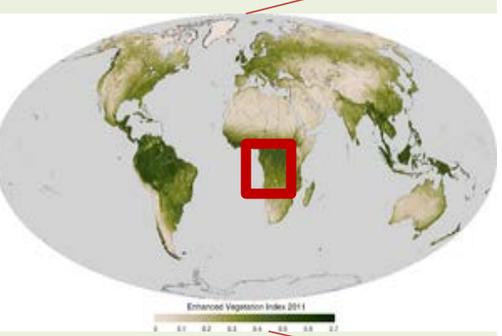
Metodology



Field Work

- Inventory design
- Field Data adquisition
- Inventory data processing
- Cluster modeling computation
- Description of Miombo types

Geomatics Work

- Image adquisition
- Image pre-post processing
- NDVI Index calculation
- Mask of Miombo

Miombo types

Classification

Generation of thematic cartography

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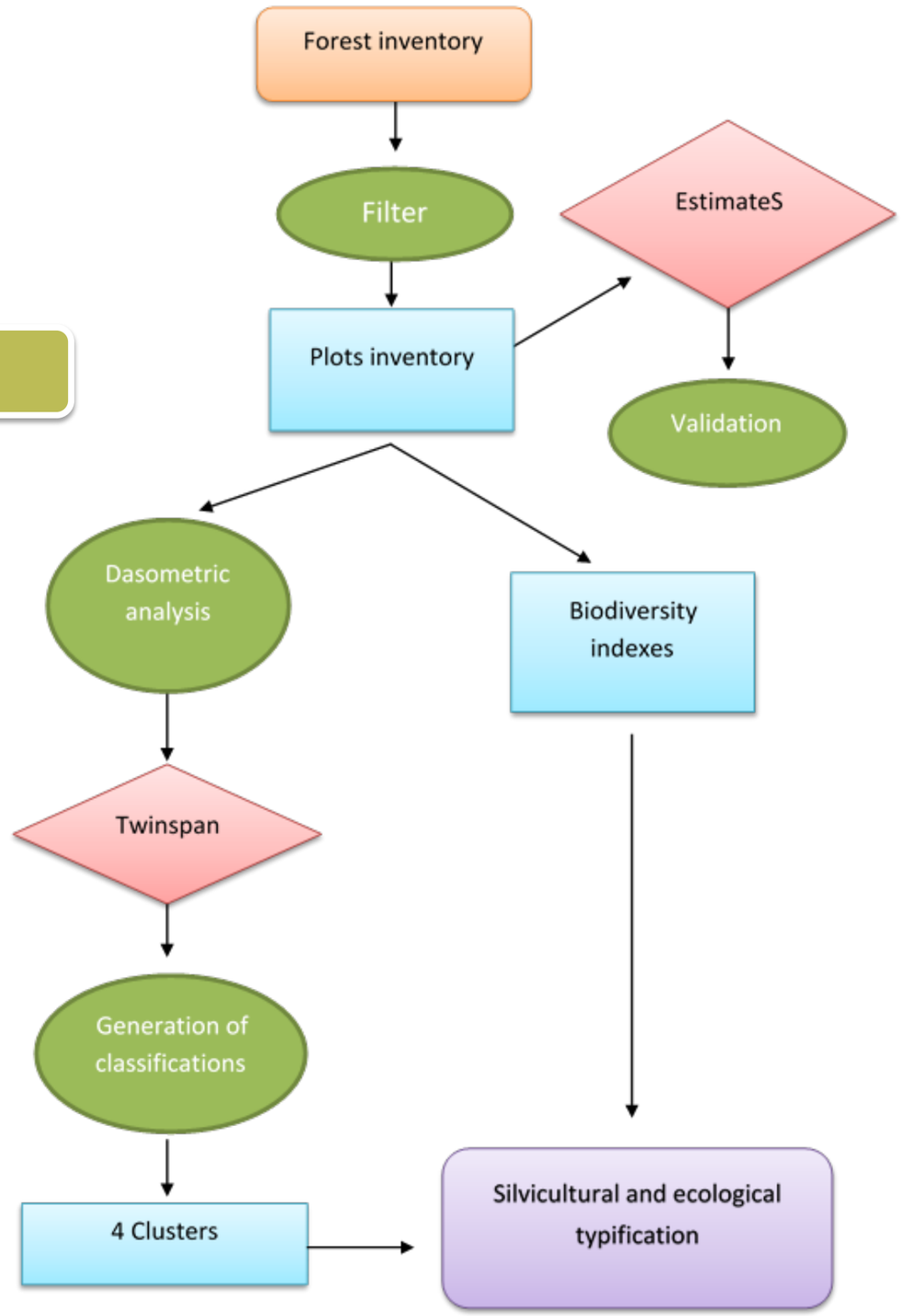
Metodology

Field Work

Workflow



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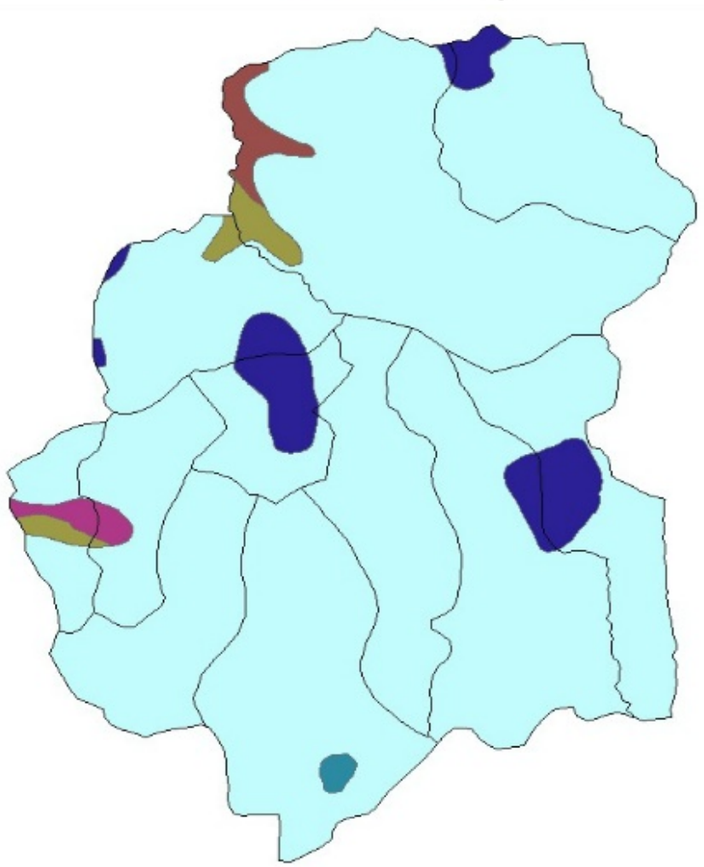
Field Work

Inventory design — **Based on the historical cartography of Huambo province**



Forest cover: *Jaxa*

Soils: *Soils of Maps 1970*

Roads: *Open Street Map 2016*

Phytogeograpy: *FAO*

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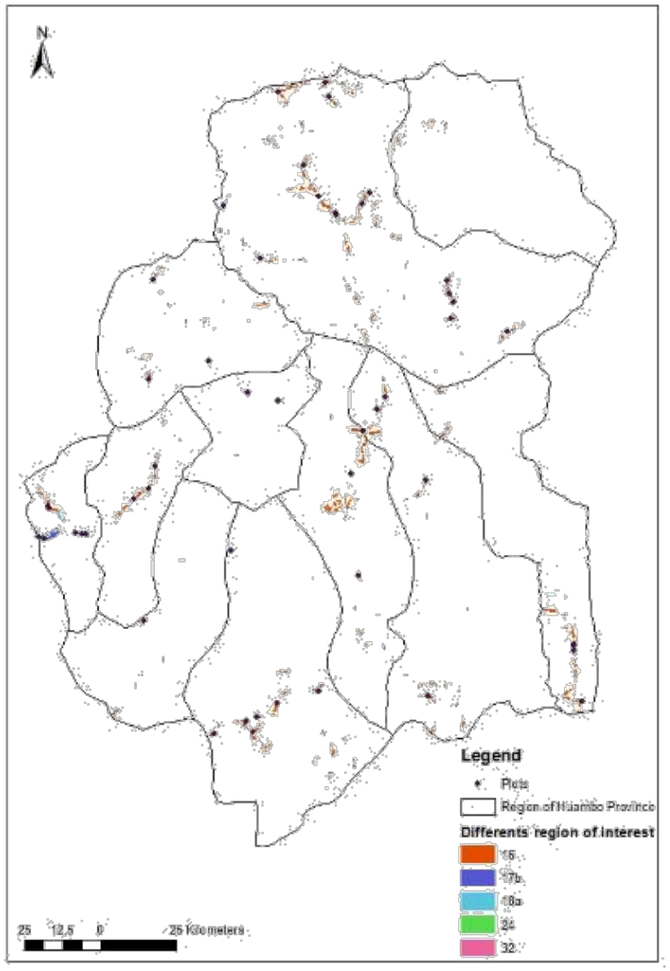
Field Work

Plots distribution

A first approximation to the different types was made to locate the plots covering the greater expected variability



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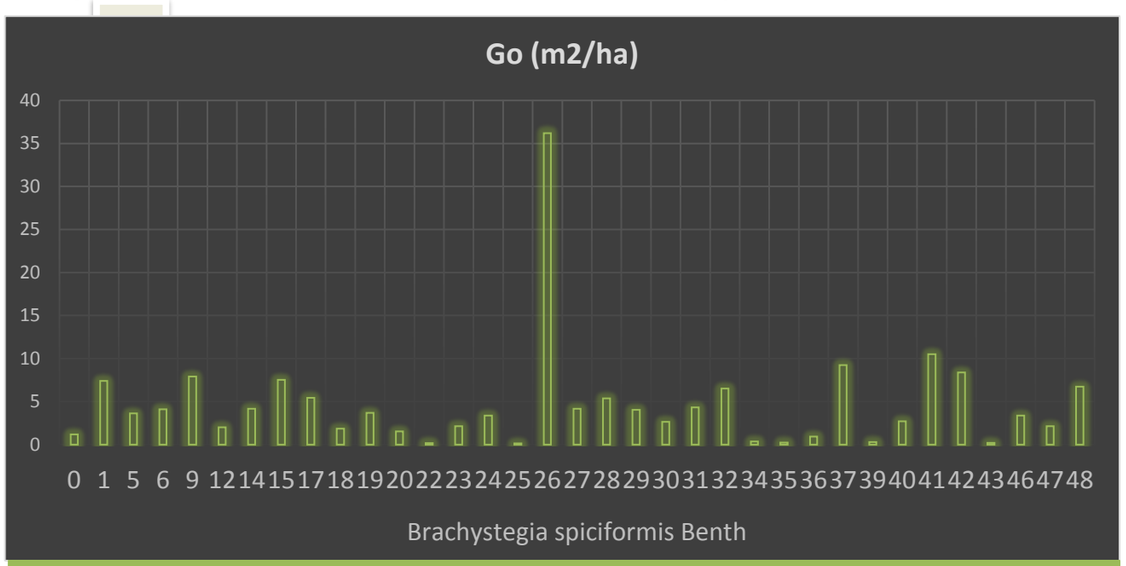
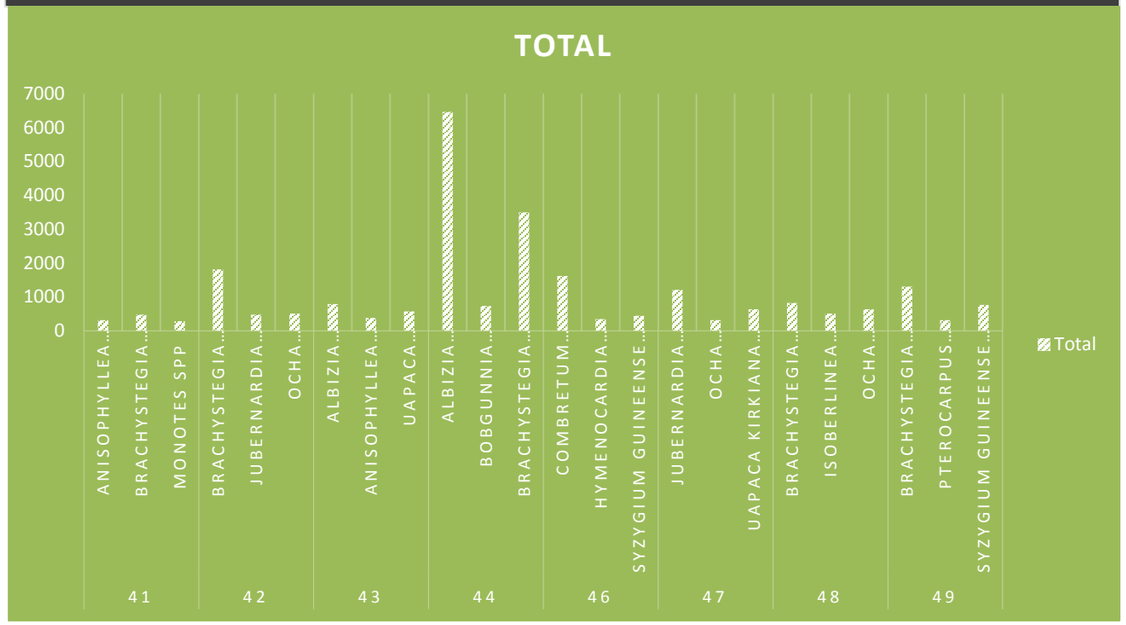
Field Work



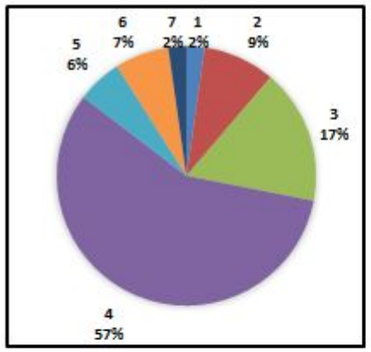


Forest Inventory Huambo			Plot	0
General description				
Sistema de referencia	WGS84 UTM 36N	**N. Totalspecies plot**		7
X	580972.281788	**Stratum**		0
Y	8686332.403333	**Plot height (m)**		1779

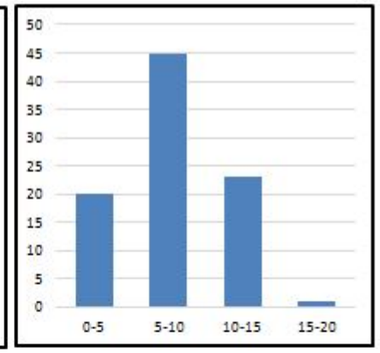
Stand composition

	*Species	D	H	G	Nplot	Nha
1	*Brachystegia Boehmii*	3.5	1.9	0.06	2	64
2	*Brachystegia spiciformis*	7.1	4.2	1.20	8	255
3	*Isorbelinea angolensis*	6.3	3.3	2.05	15	477
4	*Jubernardia paniculata*	9.0	4.4	11.47	51	1623
5	*Paninari curatelifolia*	8.0	4.7	0.90	5	159
6	*Terminalia brachystemma*	3.4	3.0	0.23	6	191
7	*Uapaca kirkiana*	7.6	2.3	0.29	2	64

Density

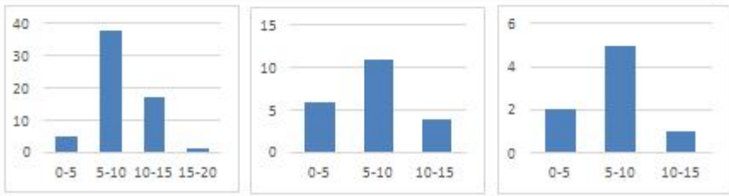


Total diameter distribution



Diameter distribution main species

Juberandia paniculata	*Isorbelinea angolensis*	*Brachystegia spiciformis*



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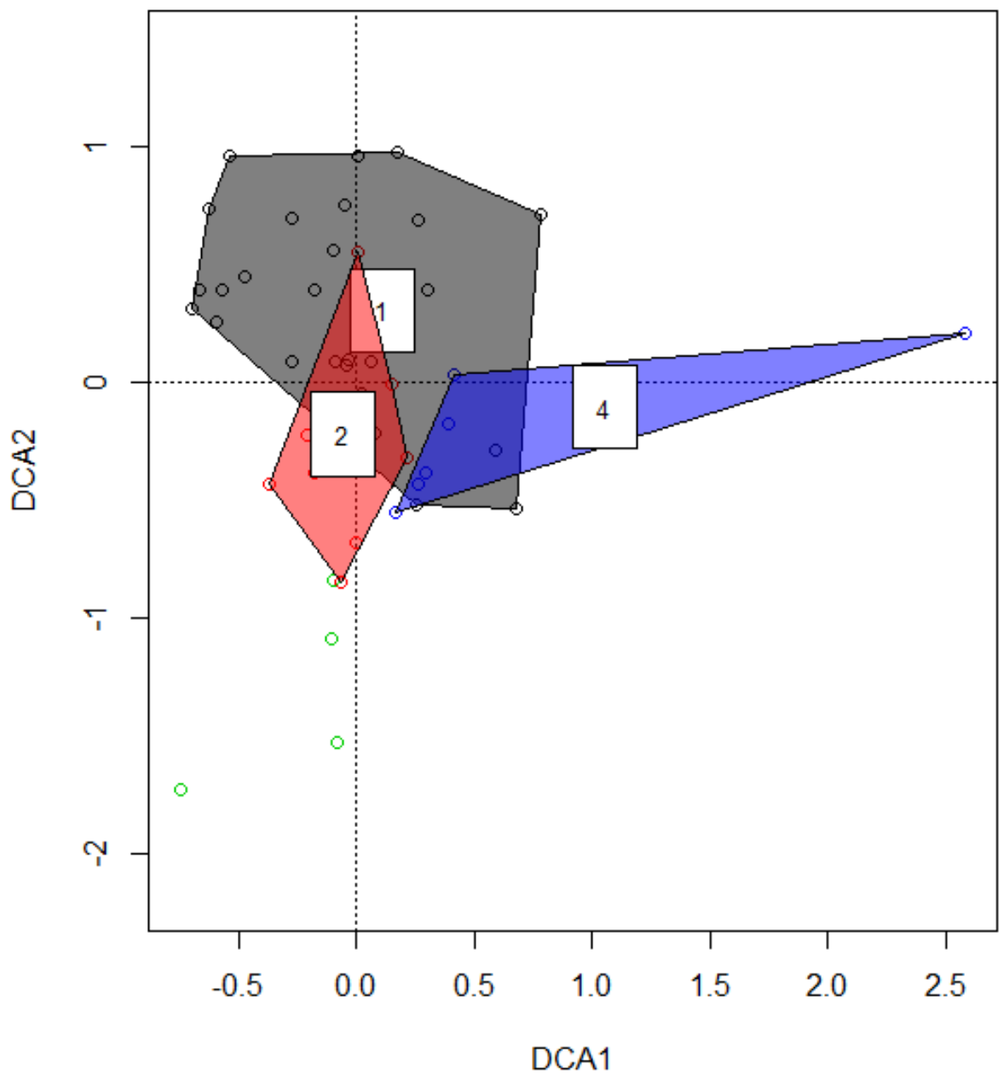
Field Work

Modified TWINSPAN



Modified TWINSPAN algorithms (Roleček et al. 2009) were computed through R statistics software.
In this case, only the dasometric measures were used as input data.

ID_parce	c_4_39
0	0
1	0
2	1
3	1
4	2
5	2
6	0
7	1
8	1
9	2
10	3
12	2
13	1
14	0
15	0
16	1
17	2
18	1
19	0
20	0
21	1
22	2
23	0
24	2
25	0
26	1
27	0
28	0
29	0
30	1
31	2
32	0
33	3
34	0
35	0
36	2
37	0
38	0
39	2
40	2
41	2
42	2
43	0
44	0
46	2
47	0
48	0
49	2

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Geomatics Work

Image acquisition

Image pre-processing

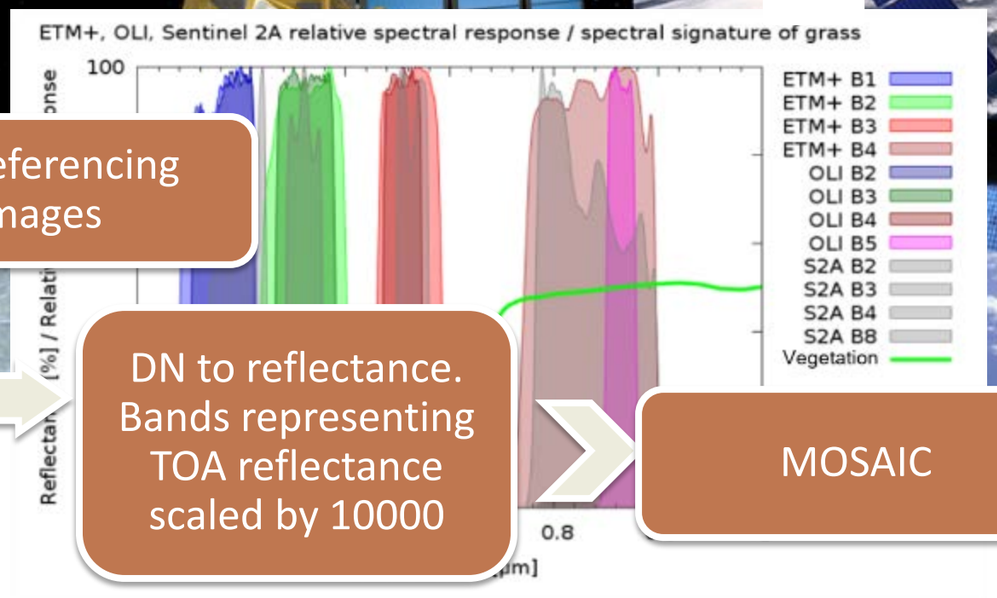
Select type of satellite

The main choice of the satellite was on spatial resolution. Landsat 7 and Landsat 8 have 30 meters of spatial resolution against Setniel-2 that have 10 meters.

Images selection with less than 5 % of clouds

Sentinel-2 Bands	C	
Band 1 - Coastal aerosol	0.443	60
Band 2 - Blue	0.490	10
Band 3 - Green	0.560	10
Band 4 - Red	0.665	10
Band 5 - Vegetation Red Edge	0.705	20
Band 6 - Vegetation Red Edge	0.740	20
Band 7 - Vegetation Red Edge	0.783	20
Band 8 - NIR	0.842	10
Band 8A - Vegetation Red Edge	0.865	20
Band 9 - Water vapour	0.945	60
Band 10 - SWIR - Cirrus	1.375	60
Band 11 - SWIR	1.610	20
Band 12 - SWIR	2.190	20

Georeferencing images



DN to reflectance. Bands representing TOA reflectance scaled by 10000

MOSAIC

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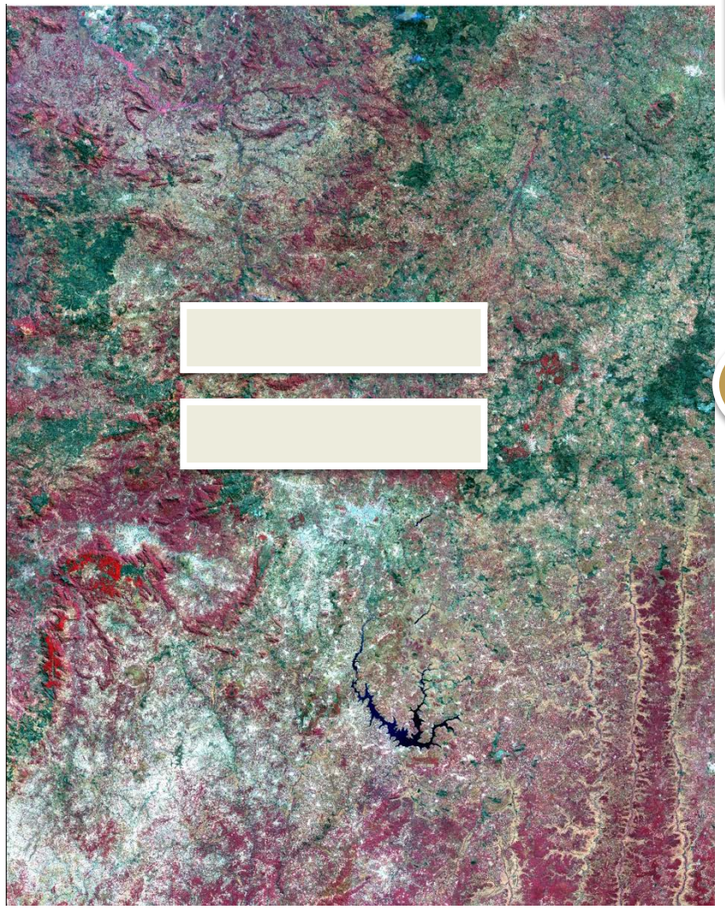
Geomatics Work

Image processing

MOSAIC



Masking forest area

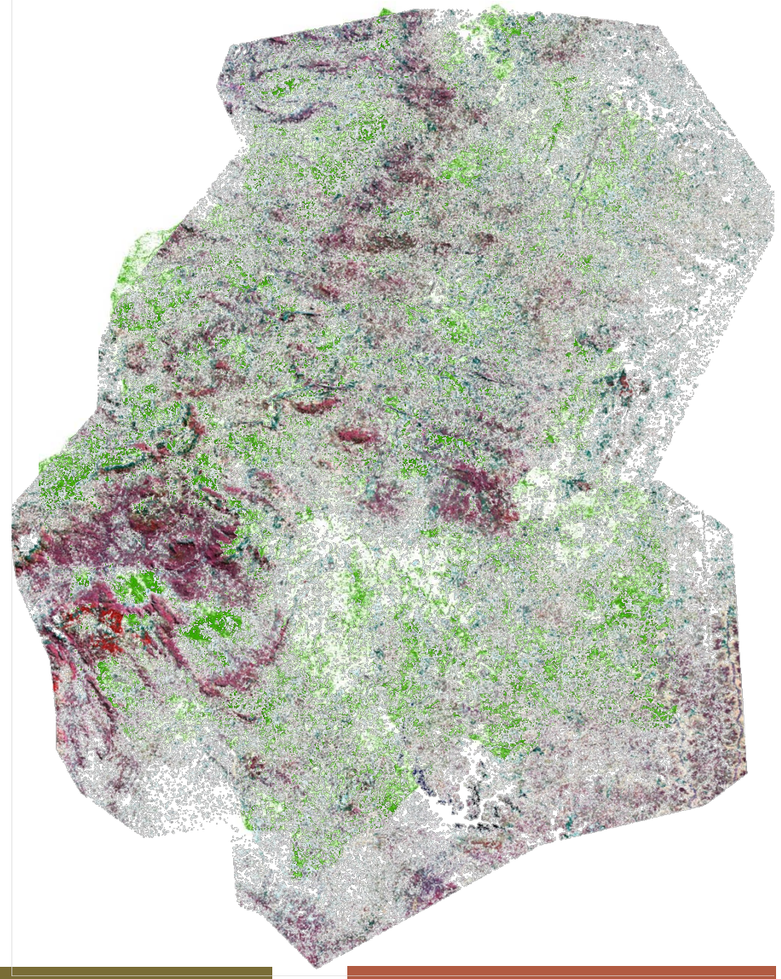


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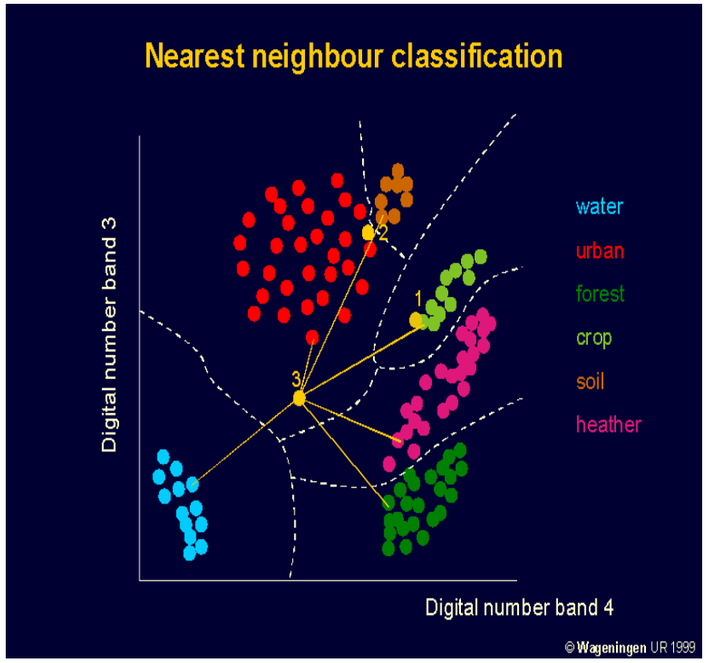
Image processing



Masking forest area

Classification

MINIMUM DISTANCE algorithm calculates the Euclidean distance d(x,y)d(x,y) between spectral signatures of image pixels and training spectral signatures

Miombo types Classification

Classification plots (4 clusters)

Training areas

Classified image

Spectral signature

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Results

Miombo types

Huambo forest (Angola)			Type 0
Description			
Number plots:	21	**Soil type:**	Orthic ferralsols
FCC (%):	49.21	**Density (N. ha^{-1})**	2147
Total species:	30	**Shannon´s Index**	1.85
Plots:	0, 1, 6, 14, 15, 19, 20, 23, 25, 27, 28, 29, 32, 34, 35, 37, 38, 43, 44, 47 and 48		

Stratum description

The main species are composed of the genus *Brachystegia* spp., and *Isoberlinia angolensis* (Benth.) Hoyle & Brenan, being both dominant species of Miombo (Campbell *et al*., 1996). Species diversity is smaller than in stratum 1 and 2. Most trees have a diameter of less than 7.5 cm; This may indicate that it is a type of young forest, but of a consolidated dynamics due to its diametrical distribution.

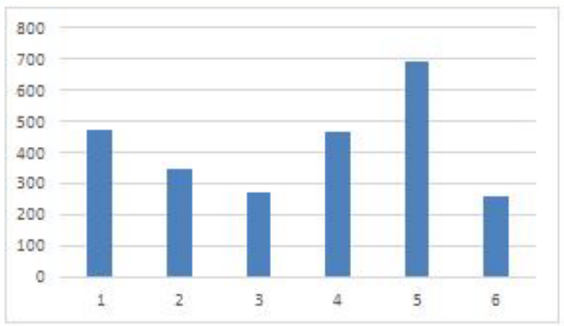
Stand composition main species

	Species	D	H	G	DMC	Nha^{-1}
1	*Brachystegia spiciformis* Benth	9.21	6.69	3.71	0.098	475.69
2	*Brachystegia bohemii*	9.92	5.66	2.38	0.106	345.4
3	*Isoberlinia angolensis* (Benth.) Hoyle & Brenan	8.63	5.61	1.88	0.090	273.75

Stand composition secondary species

	Species	D	H	G	DMC	N.ha^{-1}
4	*Julbernardia paniculata* (Benth.) Troupin	9.68	6.23	4.25	0.102	468.78
5	*Albizia antunesiana* Harms	8.55	5.14	4.14	0.088	693.21
6	*Anisophyllea boehmii* Engl.	8.24	5.25	1.78	0.086	257.30

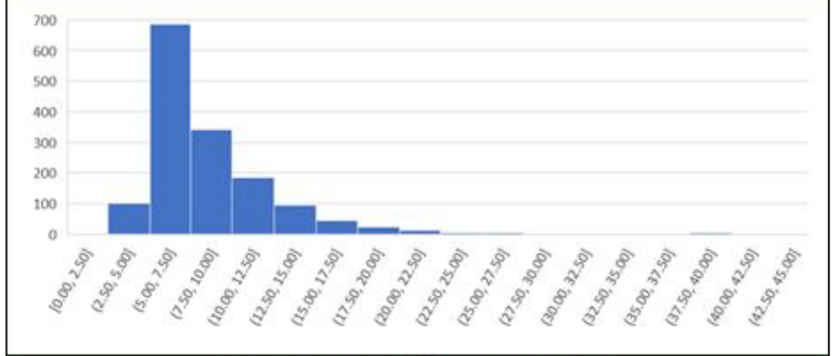
Density species (N.ha^{-1})



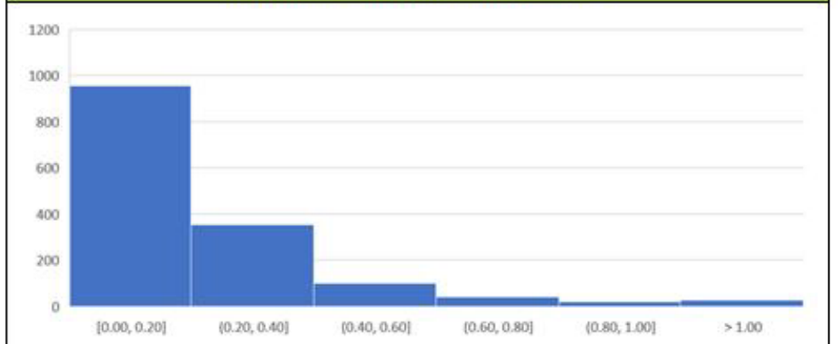
Other species present in the stratum

Babgunnia madagascariensis	*Gardenia volkensii*
Brachystegia tamarindoides	*Hymenocardia acida*
Brachystegia utilis	*Monotes spp*
Diplorhynchus condylocarpon	*Ocha schweinfurthiana*
Erythrapleum africanum	*Parinari curatellifolia*
Rothmannia engleriana	*Pericopsis angolensis*
Syzygium guineense	*Pterocarpus angolensis*
Uapaca gossweileri	*Terminalia brachystemma*
	Uapaca Kirkiana

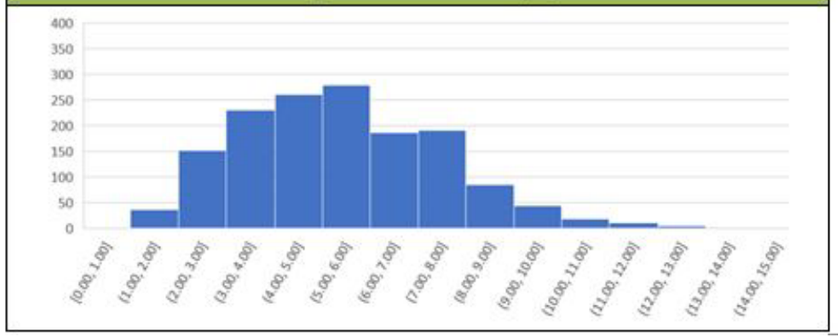
Diameter distribution (cm)



Basimetric distribution (m^2.ha^{-1})



Heights distribution (m)



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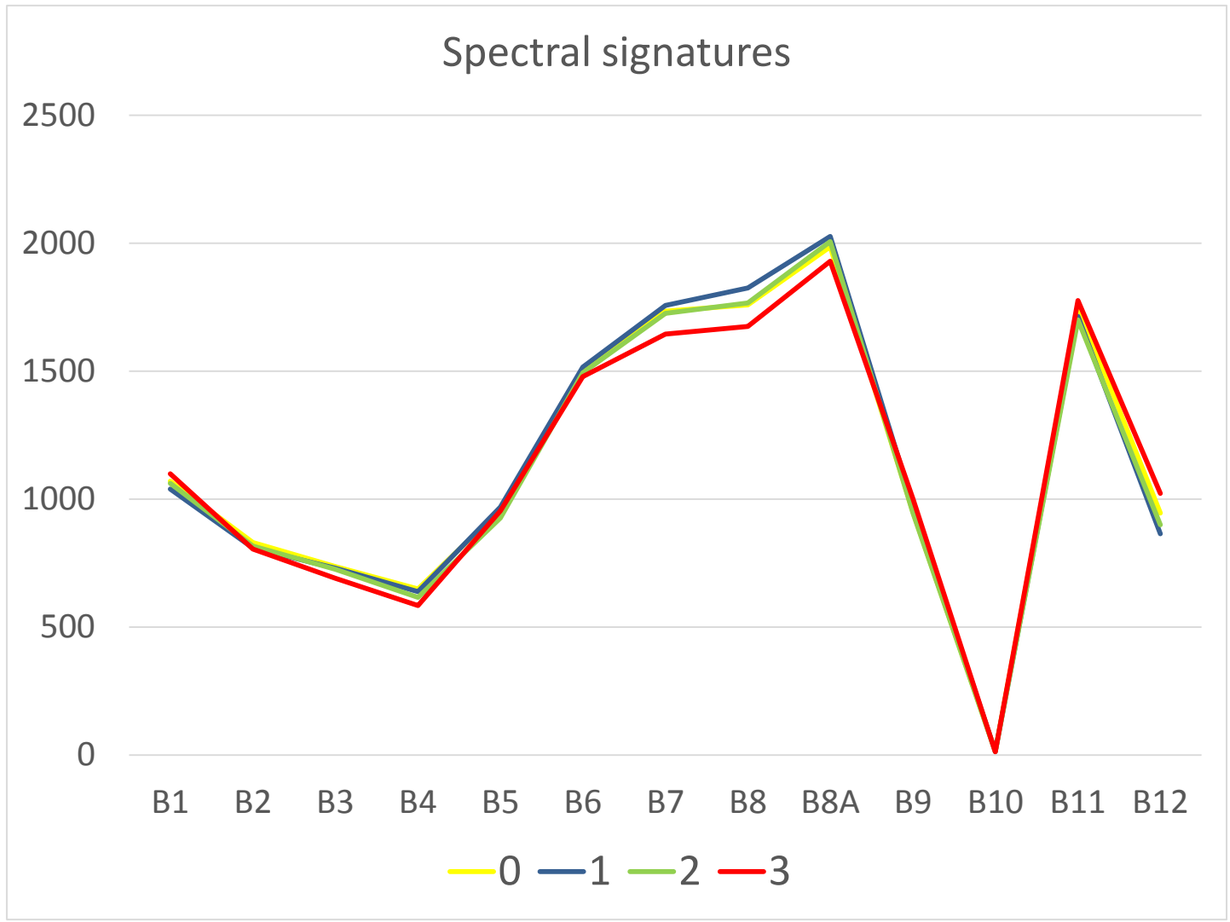
Results

Classification of miombo types

Spectral signatures



The spectral signature for each type of miombo was calculated once the four types of miombo were obtained

Training areas

Miombo types	Number of plots
0	15
1	7
2	11
3	1

The training areas selected correspond to the field plots classified based on the four types of miombo defined (0, 1, 2 and 3)

70% of total plots used in the classification

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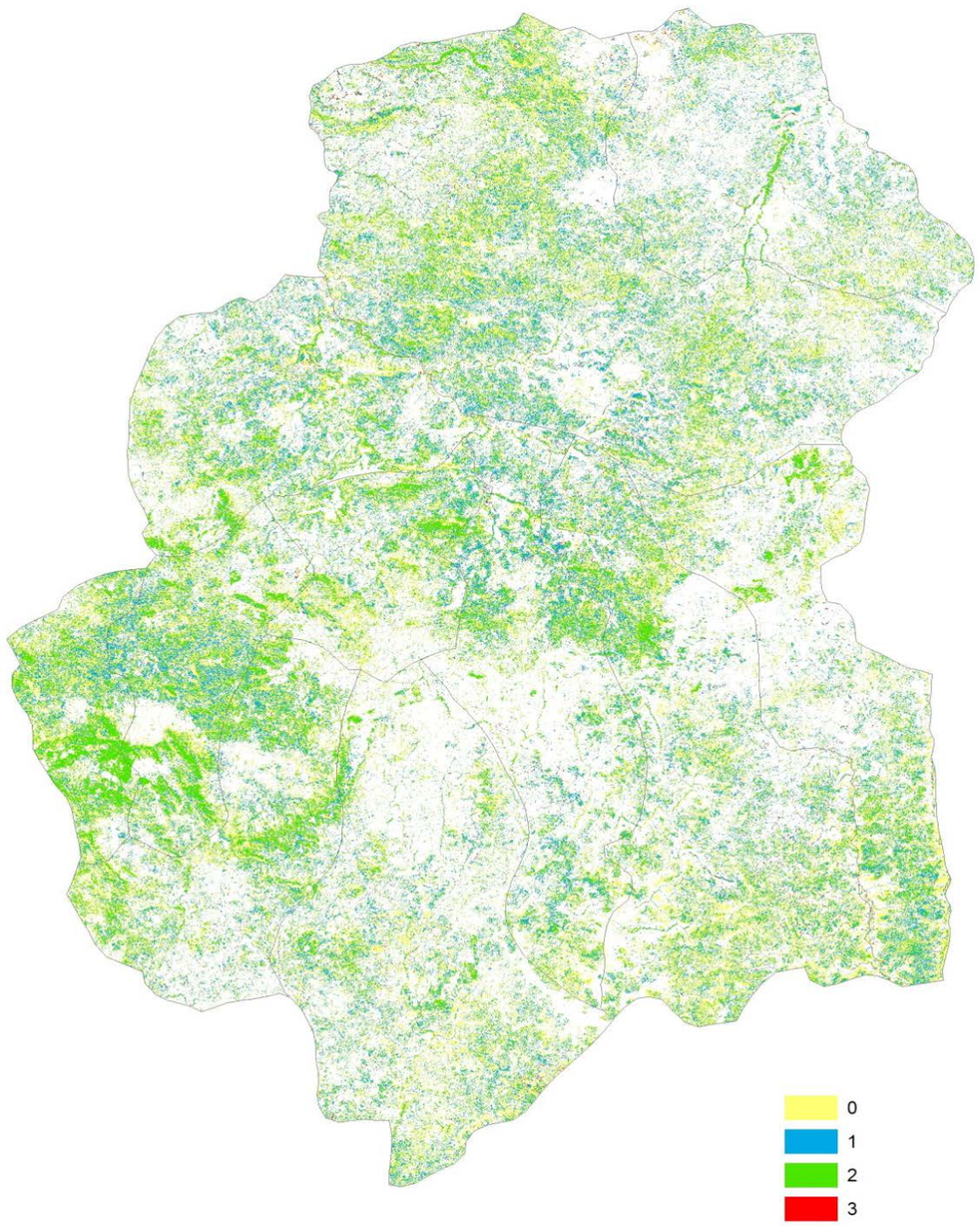

Type of miombo 0: 63 487.64 ha

Type of miombo 1: 31 913.42 ha

Type of miombo 2: 34 965.27 ha

Type of miombo 3: 18 072.12 ha

Classification accuracy 46%

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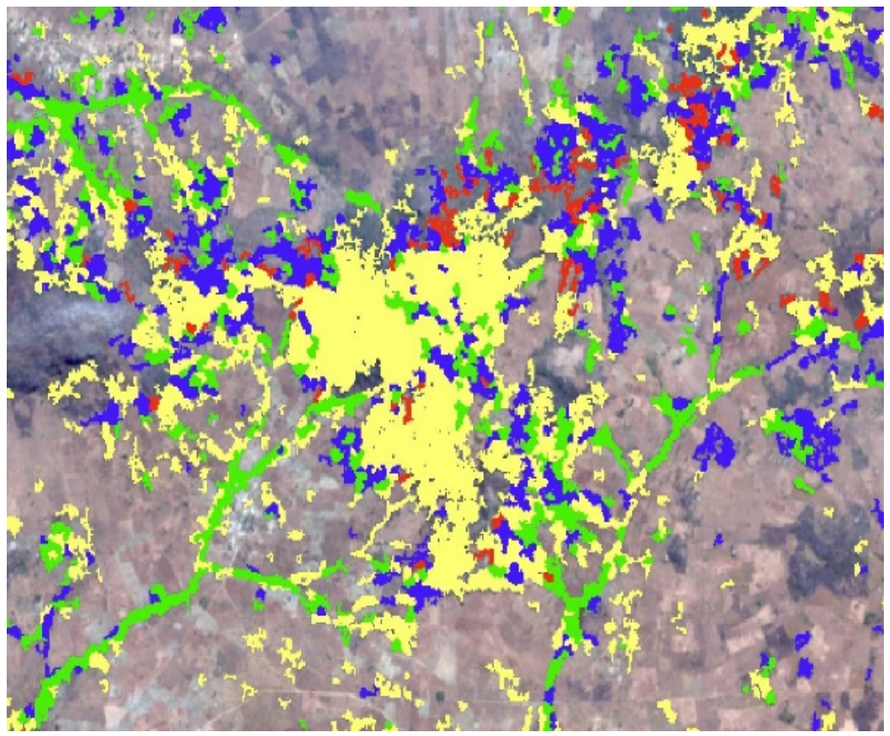
Classification of miombo types

Miombo Type 0



- Forest with typical features of an intermediate state between degraded and mature miombo

- The low slope makes it accessible to other traditional uses such as firewood, charcoal, the extraction of wild fruits or livestock

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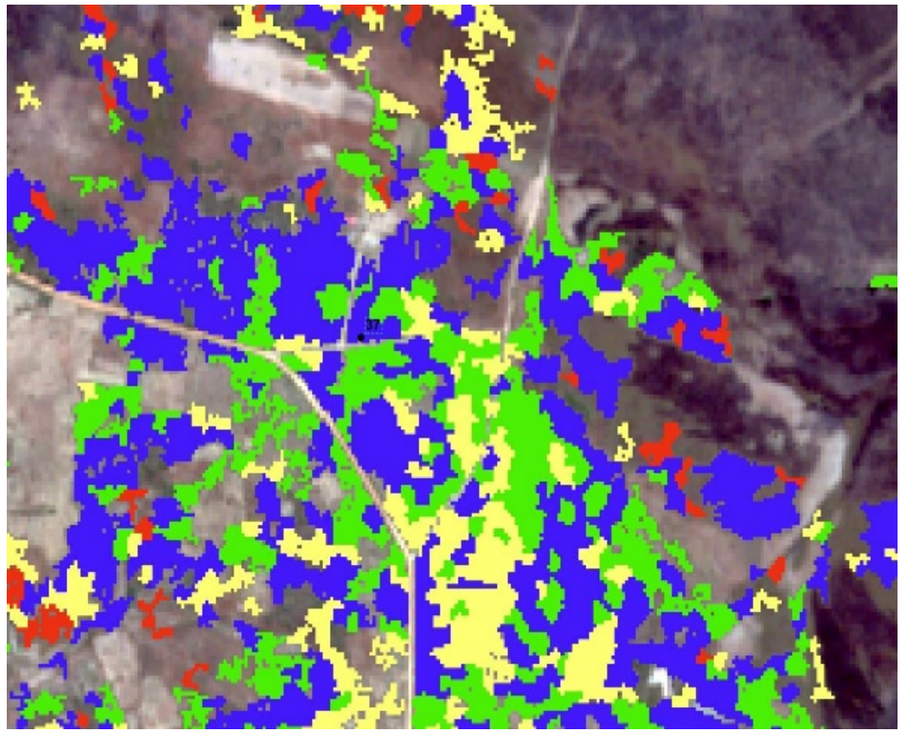
Classification of miombo types

Miombo Type1



- **Forest intervened**

- **Forest concentrated around the communication routes, and in areas with low slope. Easy access Of the population for the extraction of timber and non-timber resources**

1. Objetives
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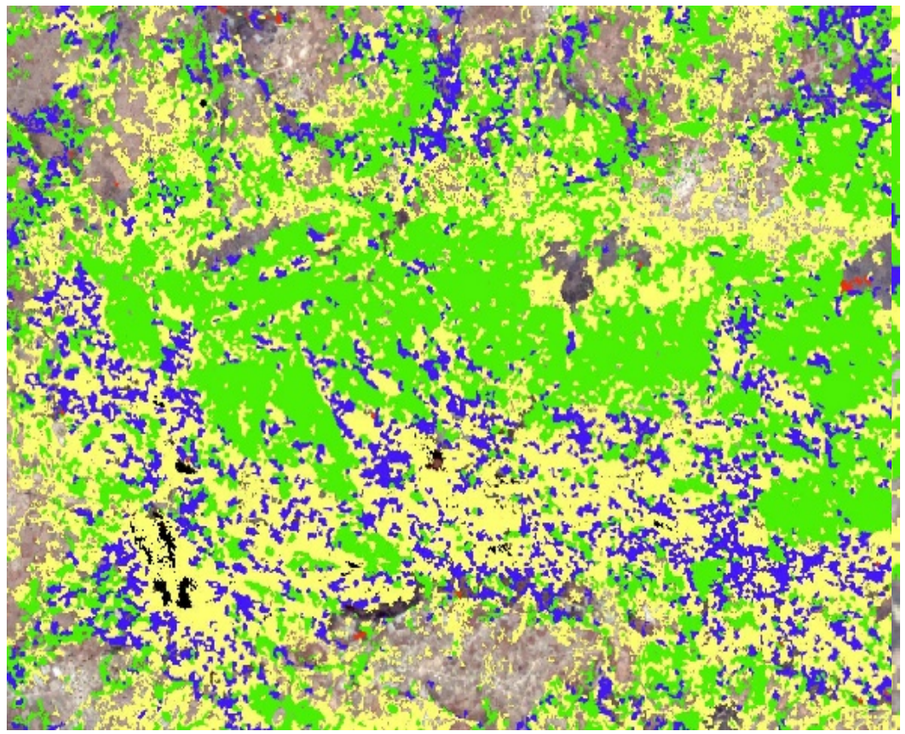
Results

Classification of miombo types

Miombo Type 2



- Mature miombo is grouped in the mountainous areas with difficult access, but with less slope and can therefore afford a greater soil thickness
- Forest in small spots, especially in the areas of greater slope or more inaccessible
- The location of this type of forest hinders human access and important logging and burning activities for later cultivation

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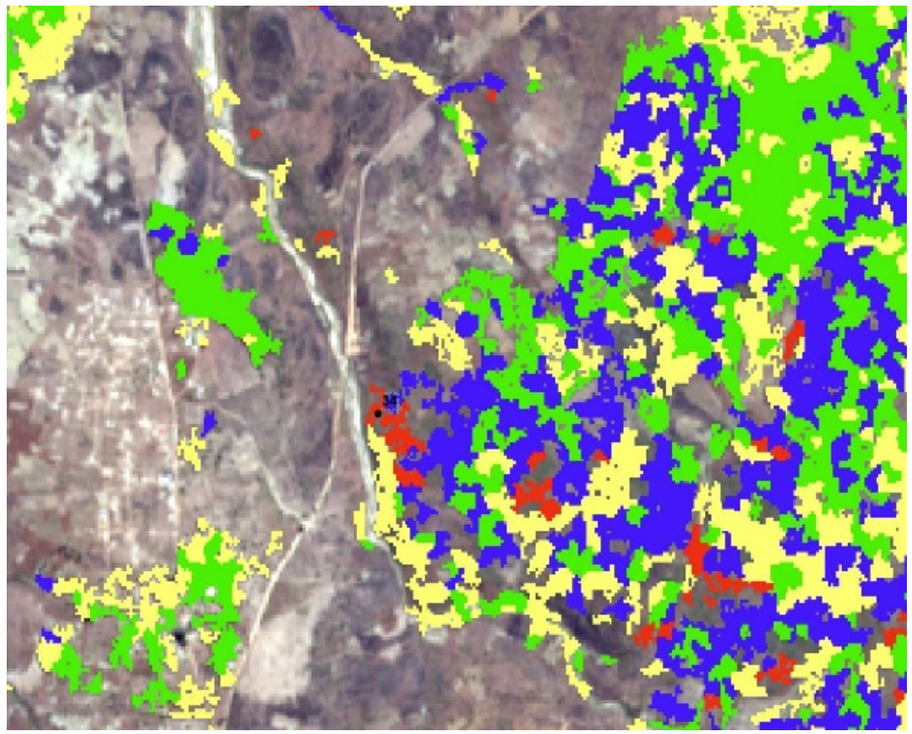
Results

Classification of miombo types

Miombo Type 3



- Forest found in the margins of the forest mass, near roads, or close to populations
- This forest presented a high degree of degradaton and a lesser extend

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Conclusions

➢ **The classification has been carried out on a single type of forest mass (miombo) so he result of the classification could be explained due to the context of the study and the reality of the data. In advanced stages of degradation, where forest cover is low, the greater presence of soil in the image would also cause a distortion of the data.**

➢ **A 10-by-10-meter pixel such as that of the Sentinel-2 image will probably not be a pure pixel.**
It will be a pixel that will mix the spectral signature of a type of miombo with that of the ground

➢**The analysis and processing of the inventory data made it possible to differntiate four types of miombo. After the exhaustive study of silvicultural characterization of the different types of miombo, it has made a classification considering this characterization and the characteristics of the study area in terms of slope, climate, spatial distribution and soil composition.**

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MAPPING TYPIFICATION OF MIOMBO USING MEDIUM AND HIGHT RESOLUTION SATELLITE IMAGE (HUAMBO-ANGOLA)