# Creation of homogeneous management units with the tool Hot Spot Analysis (Getis-Ord) in a study case of a degraded Argentinian cloud forest assessed with UAV imagery.

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# Introduction

- Forest degradation in Argentina

- Strict forest law

  - Delineate homogeneously stocked forest

  - Create FMUs

# Objectives

- Map and classify forest by fire severity on a site scale (4000 ha) SPOT6 scene supported with CHM metrics from UAV imagery.

- Identify areas of low and high canopy cover and BA in order to create homogeneous FMU using the tool 'Hot Spot Analysis' from ArcGIS.

# Materials and methods

- Object-based segmented SPOT6 image

- Forest inventory: 77 plots in 4000 ha

- UAV flights of 2800 ha: CHM metrics (20 additional plots)

- Classification of image trained with BA
  and CHM metrics

# Materials and methods
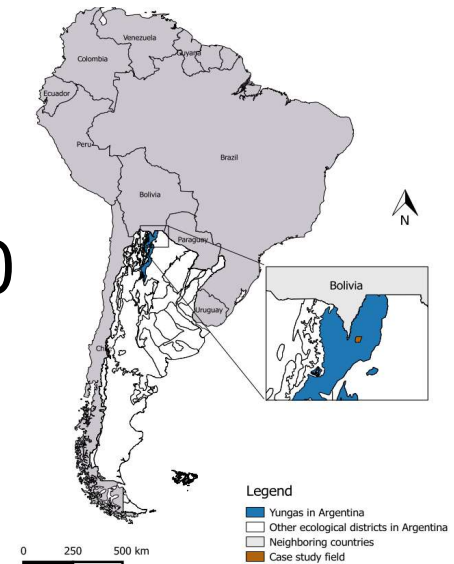
## Correlation of BA and CHM metrics

- THC1: CC (%) from trees height between 5 and 10 m
- THC2: CC (%) from trees height between 10 and 20 m
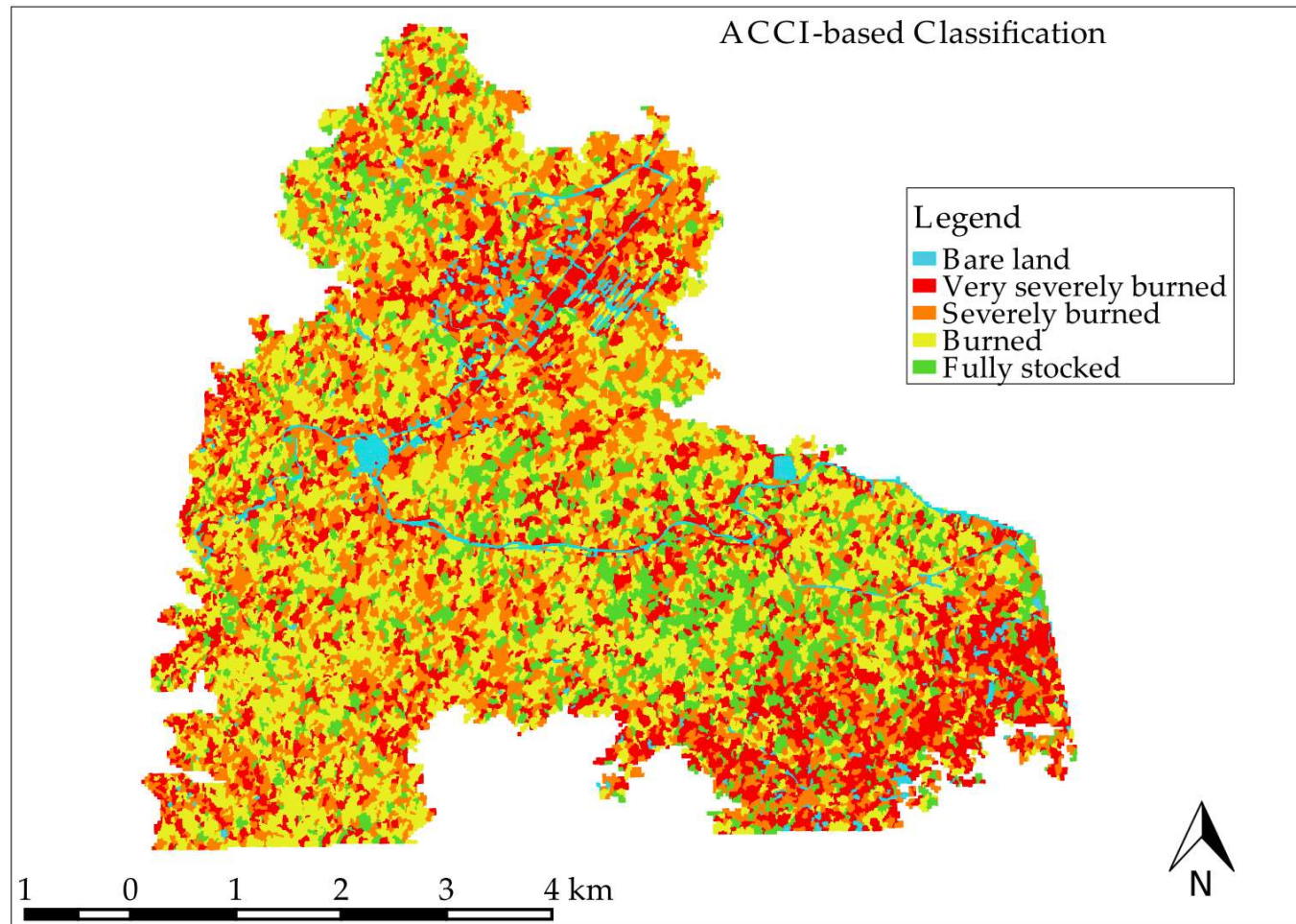- THC3: CC (%) from trees higher than 20 m

$$BA = a * THC1 + b * THC2 + c * THC3 + d$$

$$Ratio1 = \frac{a}{b} \qquad Ratio2 = \frac{c}{b}$$

$$ACCI = Ratio1 * THC1 + THC2 + Ratio2 * THC3$$

| Degradation strata | Range ACCI |
|---|---|
| Very severely burned | ≤ 20 |
| Severely burned | > 20 and ≤ 33 |
| Burned | > 33 and ≤ 66 |
| Fully stocked | > 66 |

# Materials and methods



ACCI-based Classification

Legend
- Bare land
- Very severely burned
- Severely burned
- Burned
- Fully stocked

1   0   1   2   3   4 km

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# Materials and methods

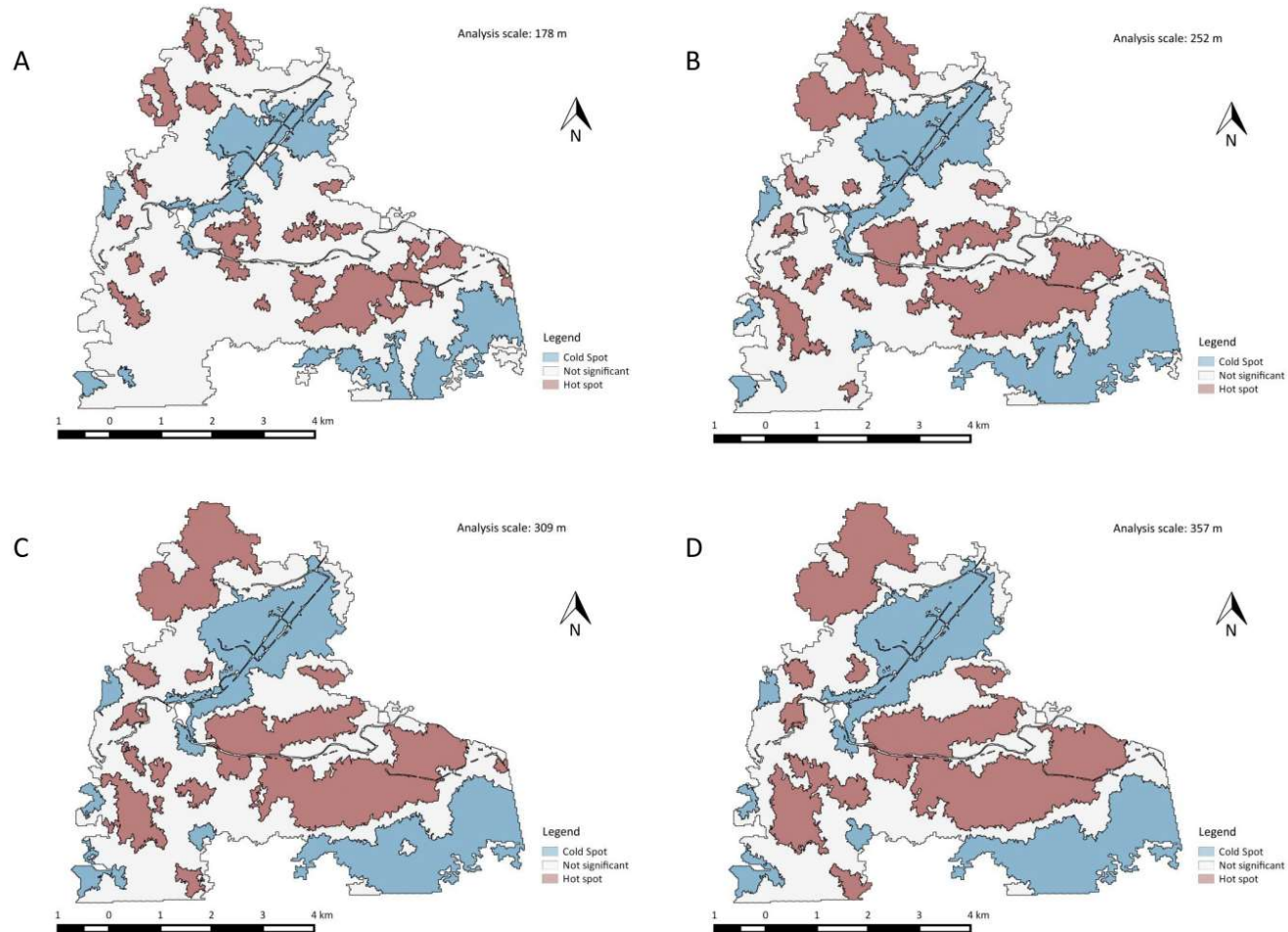- Moran's I : Overall spatial autocorrelation test
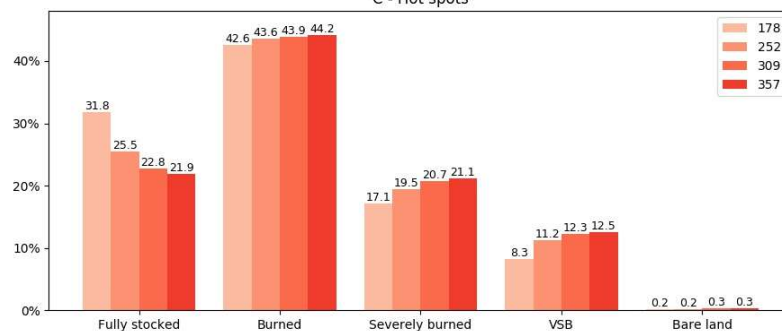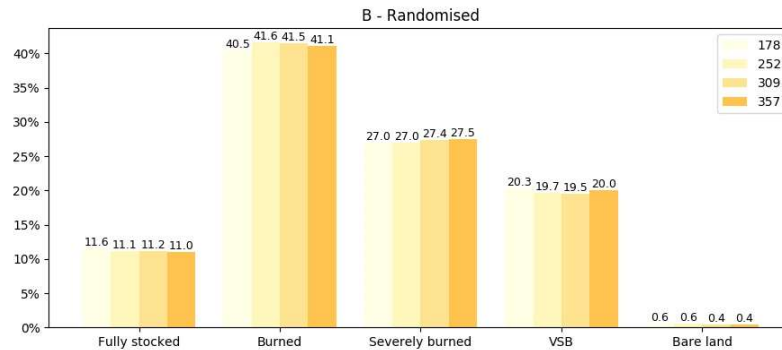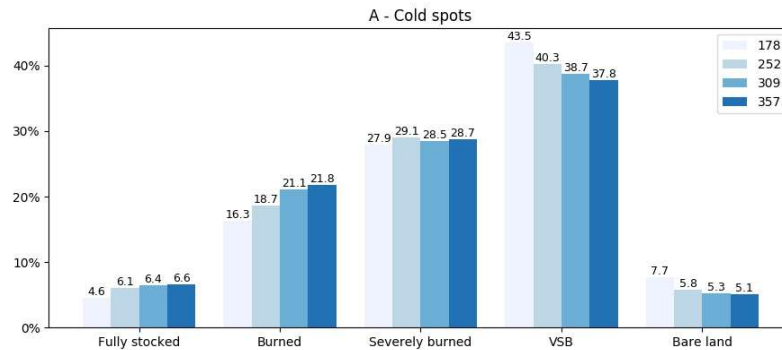
- *Getis-Ord Gi\**: $$G_i^*(d) = \frac{\sum_j w_{ij}(d)\, x_j}{\sum_j x_j}$$

- Alternative size management units-Threshold distance:
  - 178 (10 ha)
  - 252 (20 ha)
  - 309 (30 ha)
  - 357 (40 ha)

# Results

Creation of homogeneous management units with the tool Hot Spot Analysis (Getis-Ord) in a study case of a degraded cloud forest assessed with UAV imagery.

# Results



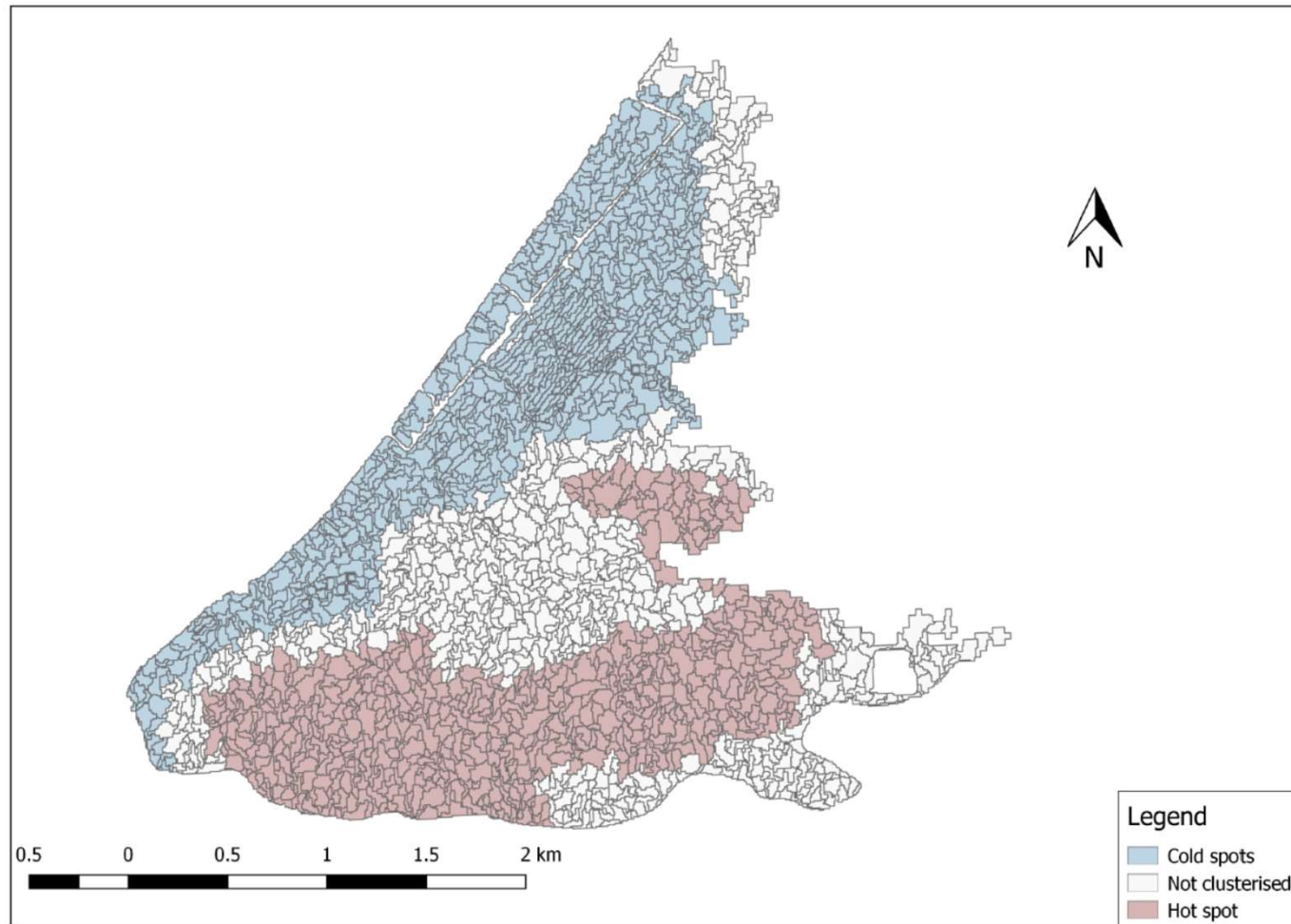| Distance threshold | Total clustered area (ha) | Total clustered area (%) | Average area of clusters (ha) |
|---|---|---|---|
| 178 | 1189.1 | 30.7 | 33.9 |
| 252 | 1810.7 | 46.8 | 72.4 |
| 309 | 2169.3 | 56.1 | 80.5 |
| 357 | 2354.6 | 60.8 | 138.5 |

# Results
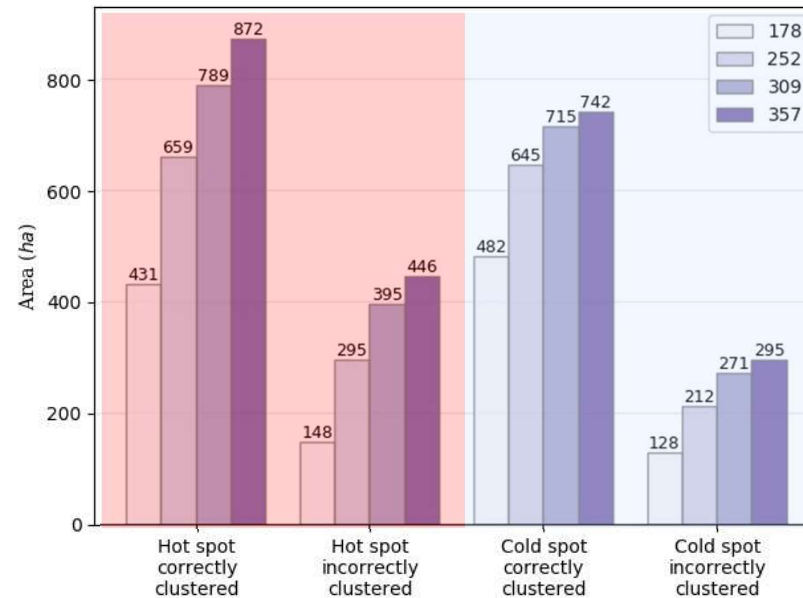


| Category | Area (ha) | Percentage of total site (%) | Increment based on total site area (%) | Sum of increments (%) | Increment based on previous threshold area (%) |
|---|---|---|---|---|---|
| Correctly clustered at 178 m | 913.3 | 23.6 | --- | | --- |
| Correctly clustered at 252 m | 1303.8 | 33.7 | 10.1 | | 30.0 |
| Correctly clustered at 309 m | 1503.8 | 38.9 | 5.2 | 18.1 | 13.3 |
| Correctly clustered at 357 m | 1613.9 | 41.7 | 2.8 | | 6.8 |
| Incorrectly clustered at 178 m | 275.8 | 7.1 | --- | | --- |
| Incorrectly clustered at 252 m | 506.9 | 13.1 | 6.0 | | 45.6 |
| Incorrectly clustered at 309 m | 665.5 | 17.2 | 4.1 | 12.0 | 23.8 |
| Incorrectly clustered at 357 m | 740.7 | 19.1 | 1.9 | | 10.2 |

# Example 750 ha- Classification

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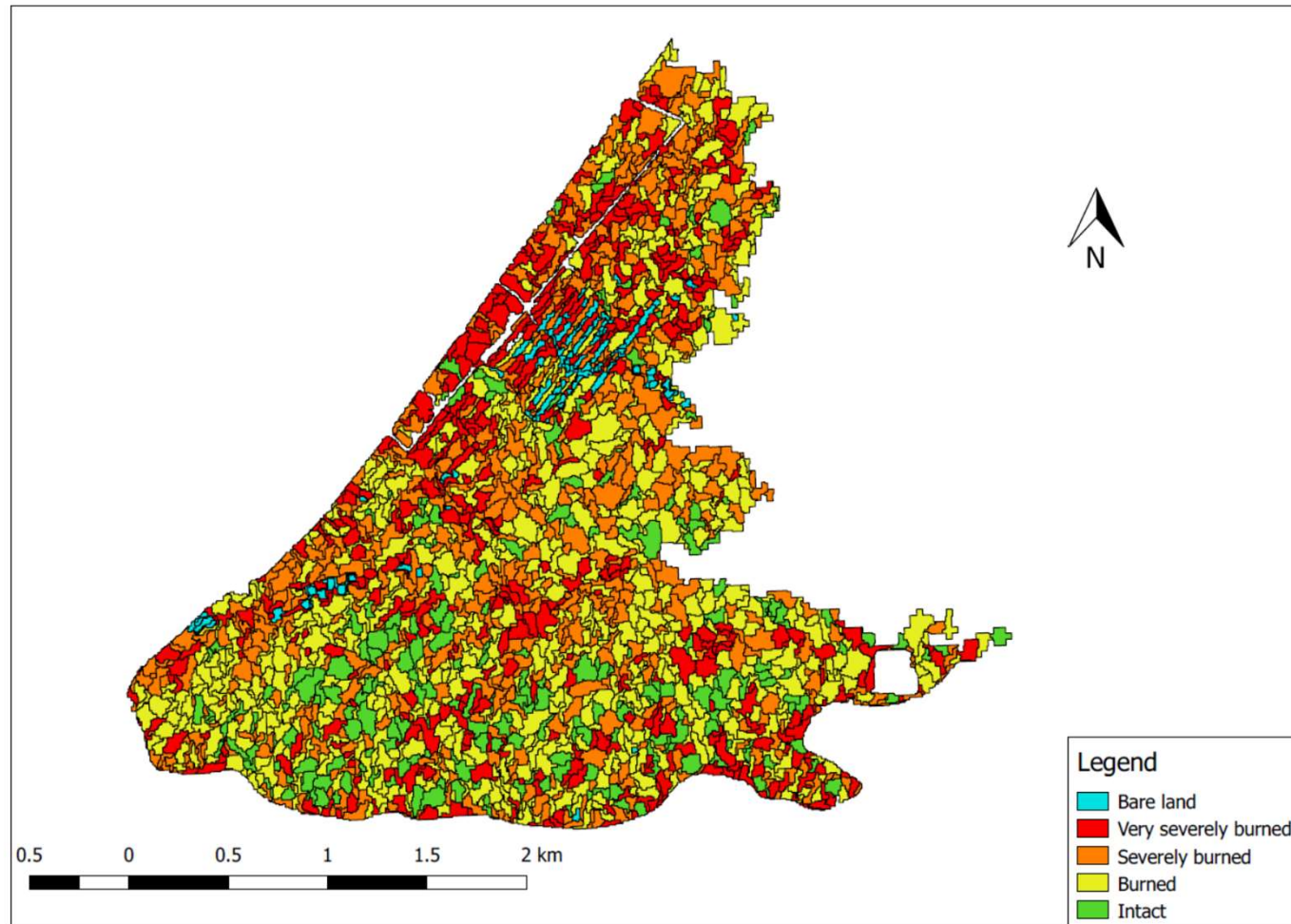
# Example 750 ha- Clusterisation

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| FMU id | Total area | EP with exotic species | EP with native species | Native forest |
|---|---|---|---|---|
| Cold spot | 239. 2 | 132.4 (55.4) | 15.8 (6.6) | 90.9 (38.0) |
| Not clustered | 242.2 | 88.9 (35.1) | 19.1 (7.5) | 145. 3 (57.4) |
| Hot spot | 253.3 | 37.4 (15.4) | 3.0 (1.3) | 201.8 (83.3) |



470 m³ (3.15 m3/ha) from the 'cold spot', 433 m³ (4 m³/ha) from the 'not clustered', and 162 m³ (4.1 m³/ha) from the 'hot spot' FMU.

Legend
- EP with ex. sp. in cold spot
- EP with nat. sp. in cold spot
- Native forest in cold spot
- EP with ex. sp. in not clusterised
- EP with nat. sp. in not clusterised
- Native forest in not clusterised
- EP with ex. sp. in hot spot
- EP with nat. sp. in hot spot
- Native forest in hot spot

0.5  0  0.5  1  1.5  2 km

# Final comments

- `Resolution paradox`

- Getis-Ord Gi* is a useful tool for the creation of homogeneous management units

- Distance thresholds: set a rule in advance

45 m

3 m

40 m

4m

Native forest

Road



Florestoona- Flight plan and inventory plots

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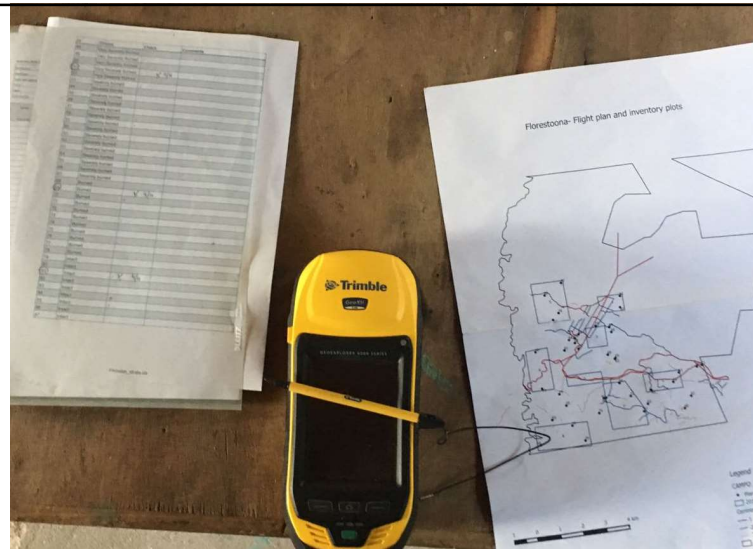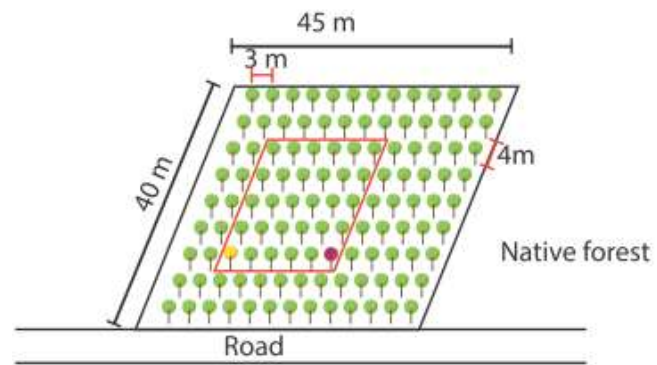
Thank you for your attention



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