

The importance of land use metrics in the design of landscape units

The study case of Centro region of Portugal



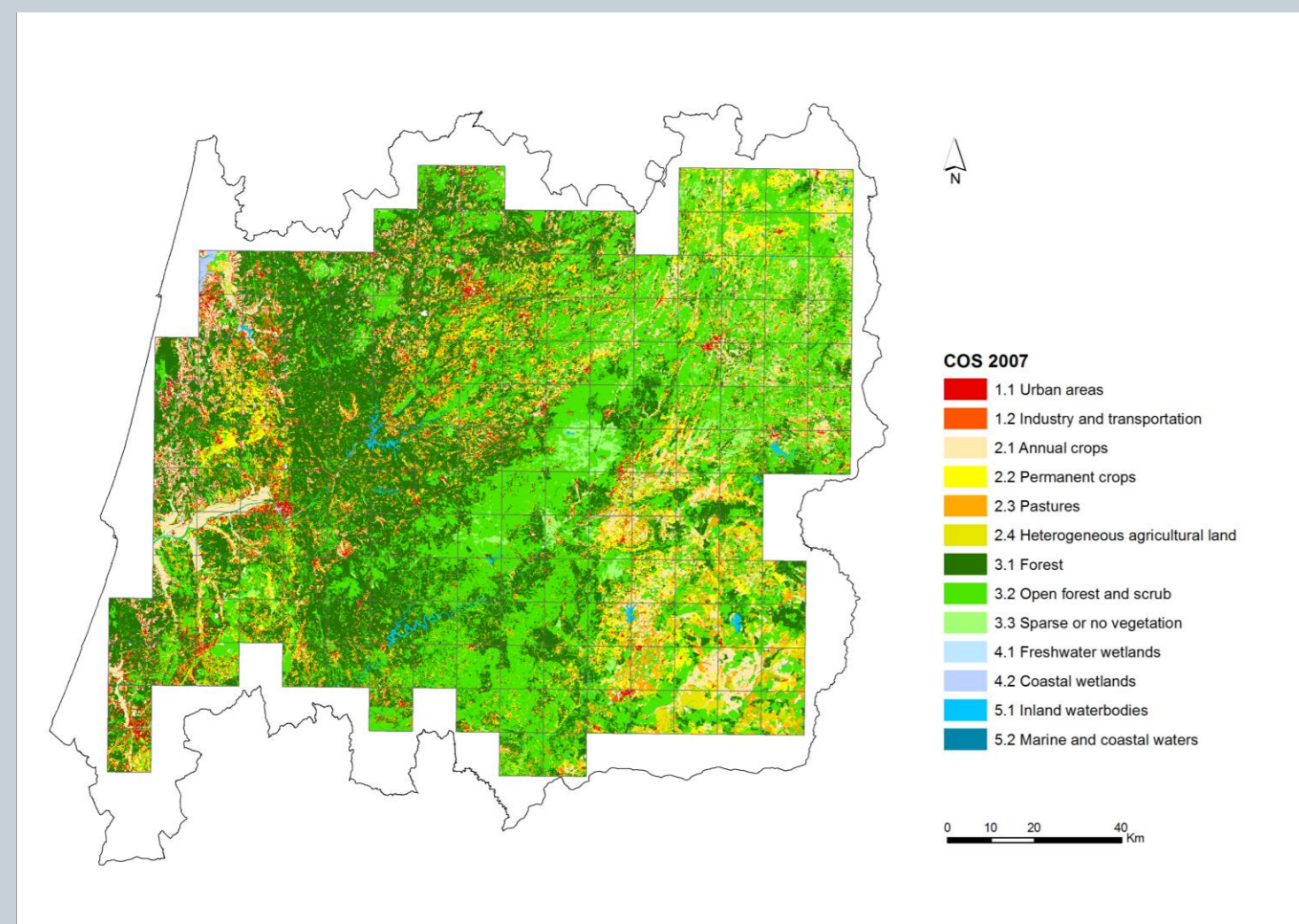
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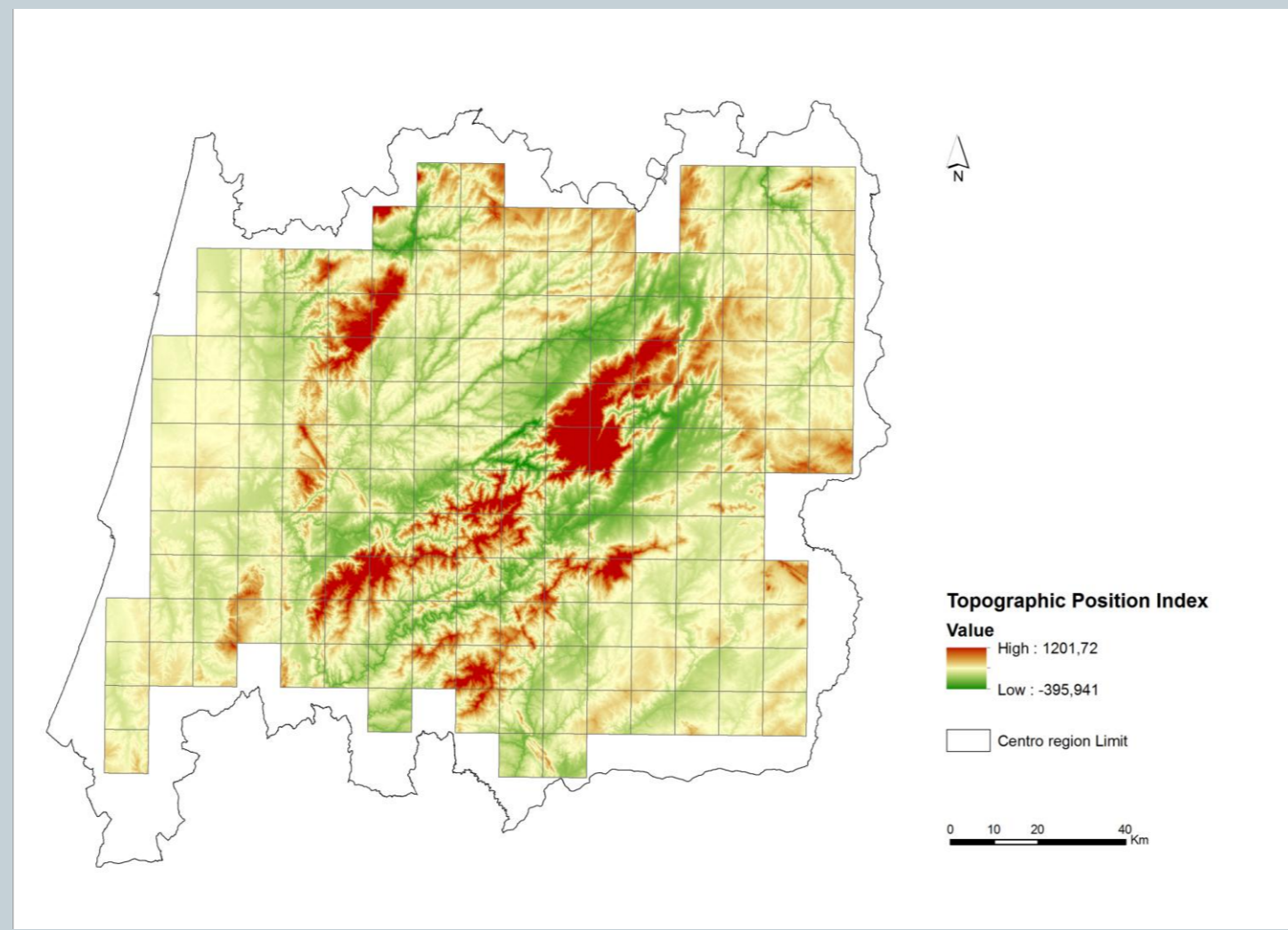


INTRODUCTION

The concept of landscape units in general refer to coherent spatial areas that are characterized by a certain degree of homogeneity concerning certain properties like natural conditions (geology, geomorphology, soils and climate) and land use. Characterization methods like the Matrix, Patch, and Corridor framework, although very useful in the description of the functional role of the geographical entities, are unable to differentiate the nature of the factors determining those entities. By the other hand, landscape metrics, defined as algorithms that quantify specific spatial characteristics of patches, classes of patches, or entire landscape mosaics, could be useful to define landscape units that have a common set of geometrical properties, referring to coherent spatial areas that are characterized by a certain degree of homogeneity concerning those properties. In this study, the Centro region of Portugal was divided in 10 km x 10 km UTM grids. A set of landscape metrics was calculated for each grid representing the land use (COS'2007 - level 3). A cluster analysis was performed in order to define groups of grids that have the same geometrical properties.

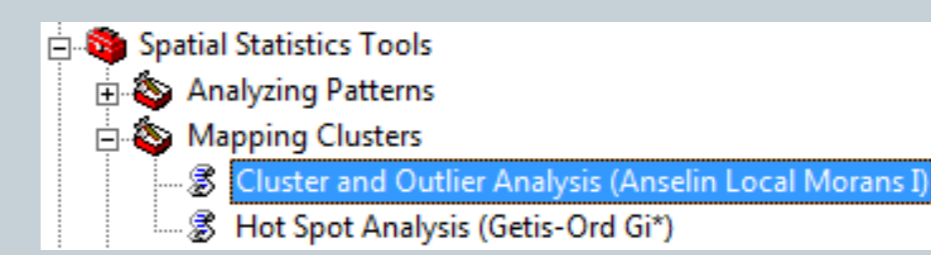


Land use map - COS'2007



Topographic position index (TPI)

A spatial autocorrelation tool was applied to the landscape metrics themes in order to identify concentrations of high values, low values, and spatial outliers. For that purpose we used the *Mapping Clusters tool of ArcGIS* (Anselin Local Moran's I statistic).



COType fields:

- **HH**: cluster of high values;
- **LL**: cluster of low values;
- **LH**: low value and is surrounded by features with high values;
- **HL**: high value and is surrounded by features with low values.

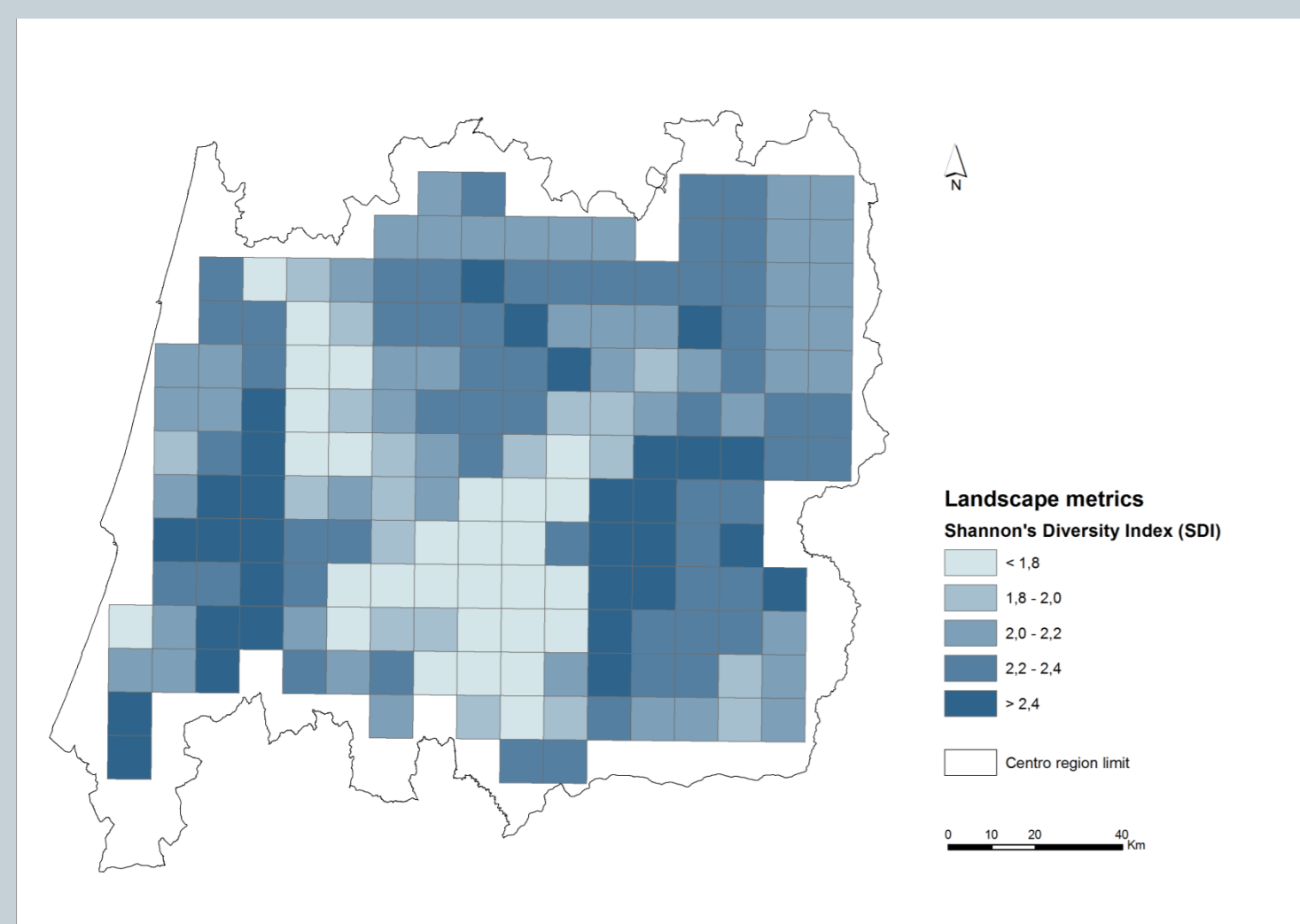
Selected Landscape Metrics

NumP	Number of Patches (NumP) Total number of patches in the landscape if "Analyze by Landscape" is selected, or Number of Patches for each individual class, if "Analyze by Class" is selected.
MPS	Mean Patch Size (MPS) Average patch size.
ED	Edge Density (ED) Amount of edge relative to the landscape area.
MSI	Mean Shape Index (MSI) Shape Complexity.
MSI	MSI is equal to 1 when all patches are circular (for polygons) or square (for rasters (grids)) and it increases with increasing patch shape irregularity.
MPAR	Mean Perimeter-Area Ratio (MPAR) Shape Complexity.
SDI	Shannon's Diversity Index (SDI) Measure of relative patch diversity. Shannon's diversity index is only available at the landscape level and is a relative measure of patch diversity. The index will equal zero when there is only one patch in the landscape and increases as the number of patch types or proportional distribution of patch types increases.

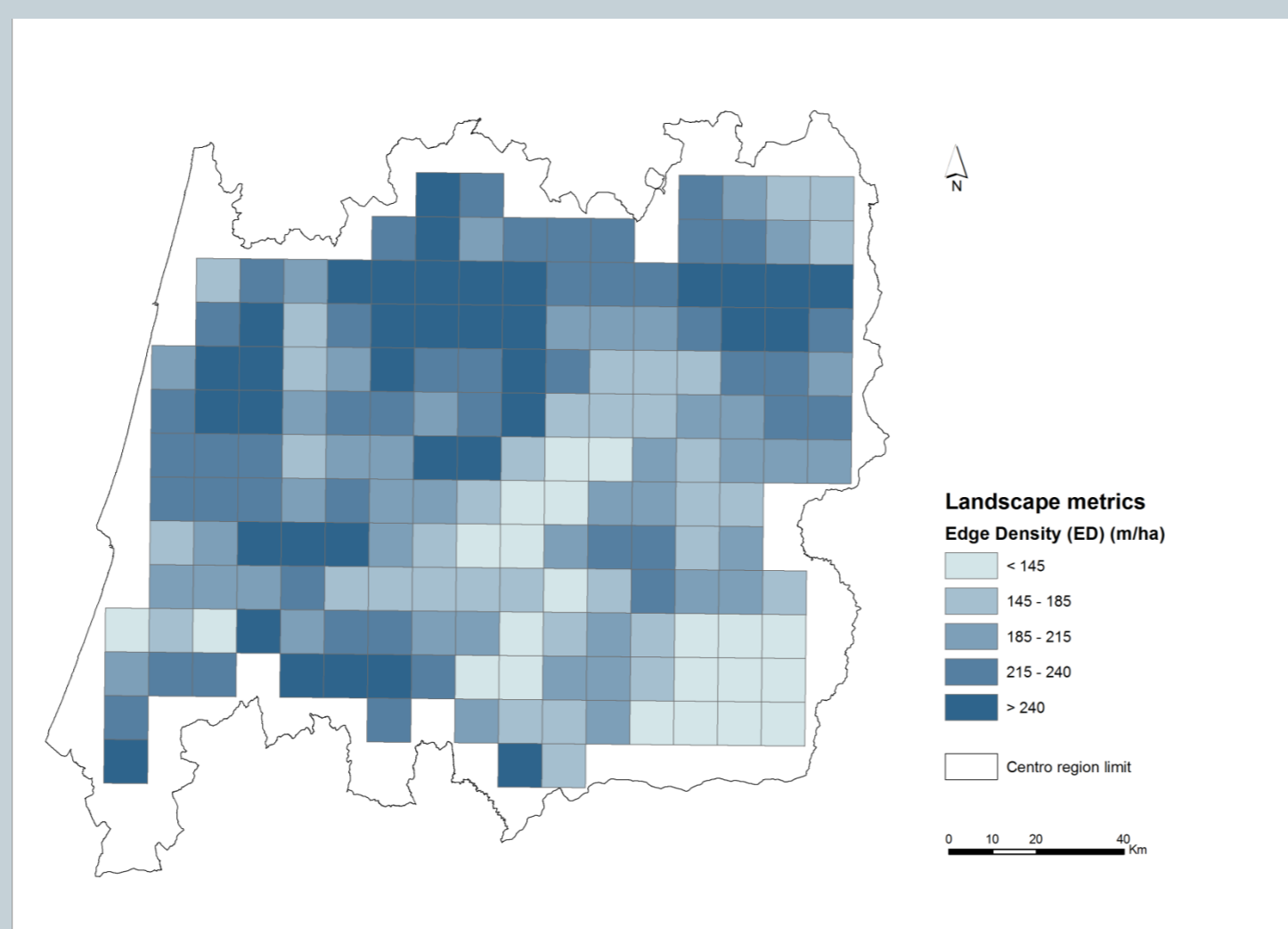
To define landscape units at a regional scale, the main features are the land use patterns (Land use map) and the stable biophysical structure (TPI).

In order to define landscape types that have a common set of geometrical properties, a set of selected landscape metrics was calculated using Patch Analyst (ArcGIS 10.2).

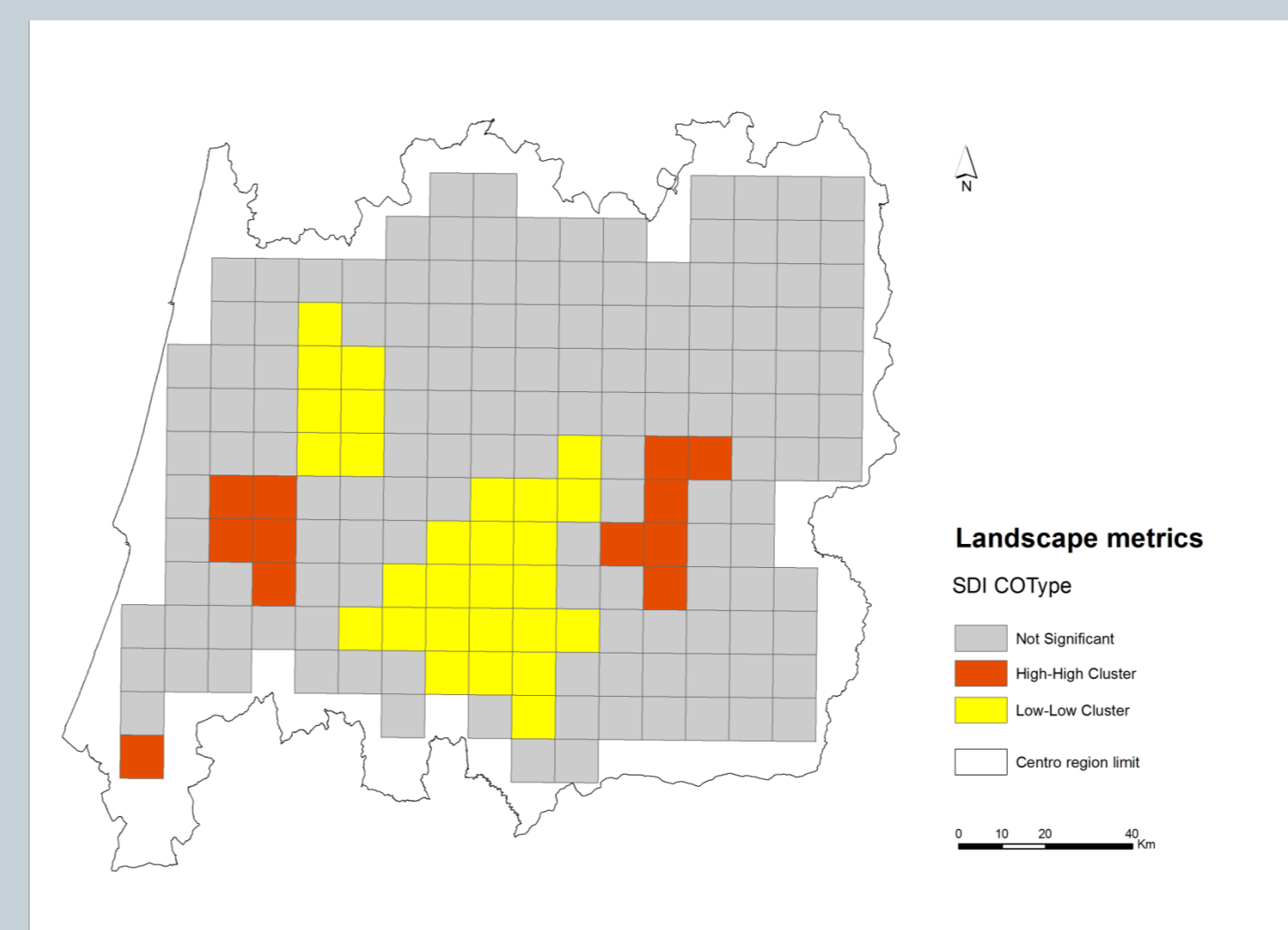
A HAC was performed to the grids based in geometrical attributes of the land use and land forms. As result 9 clusters were created.



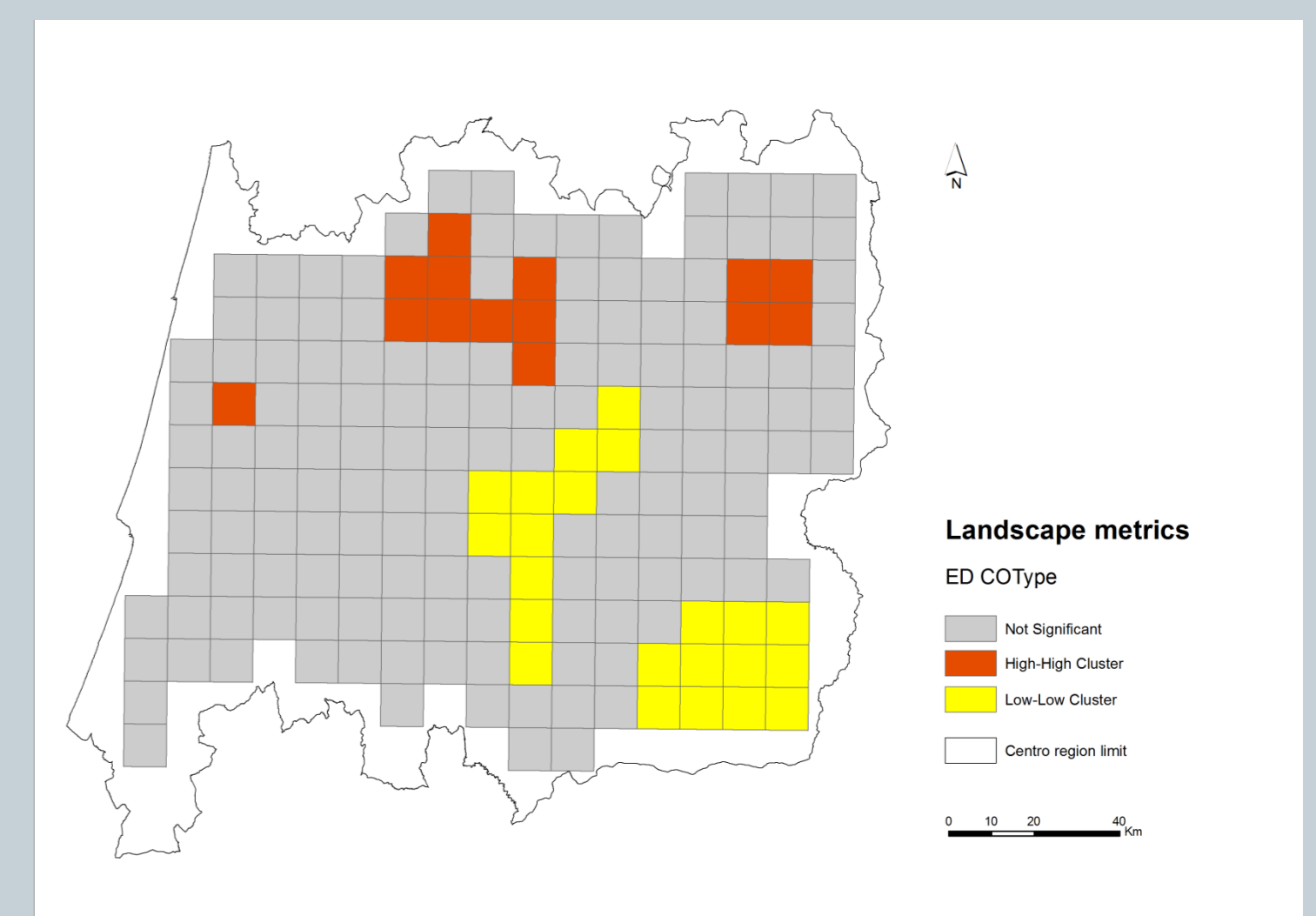
Shannon's Diversity Index (SDI)



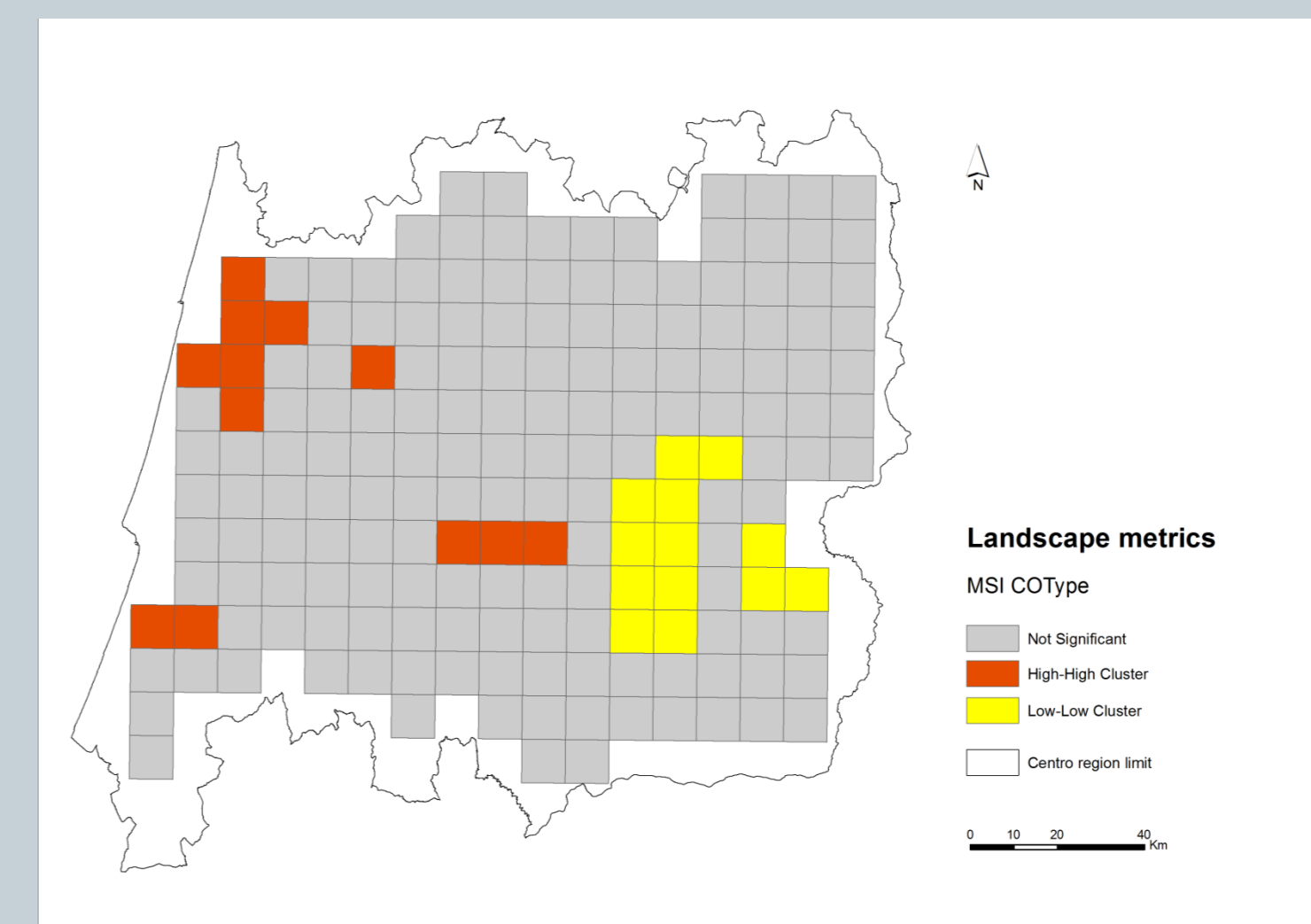
Edge Density (ED)



Shannon's Diversity Index (SDI)

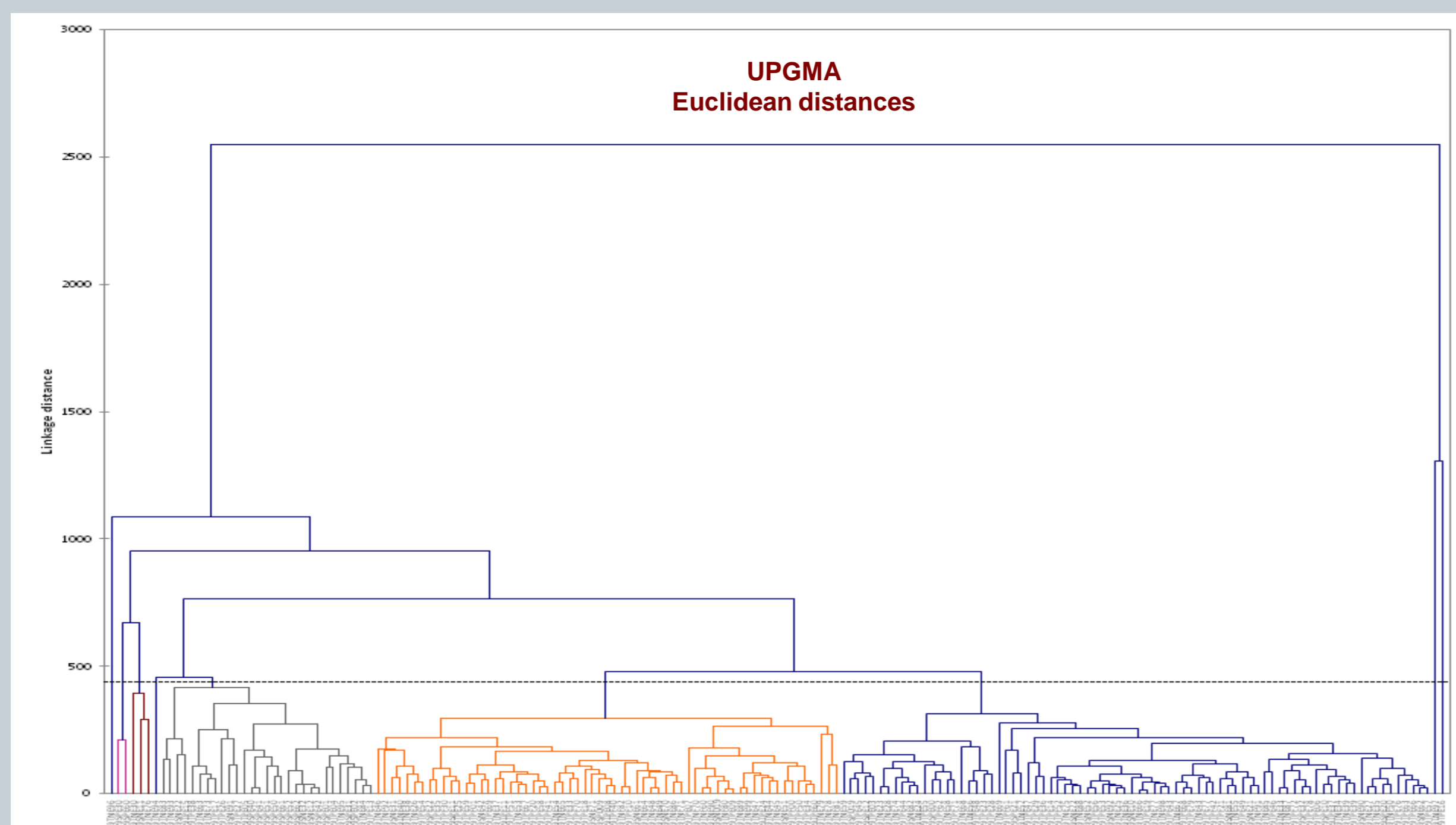


Edge Density (ED)

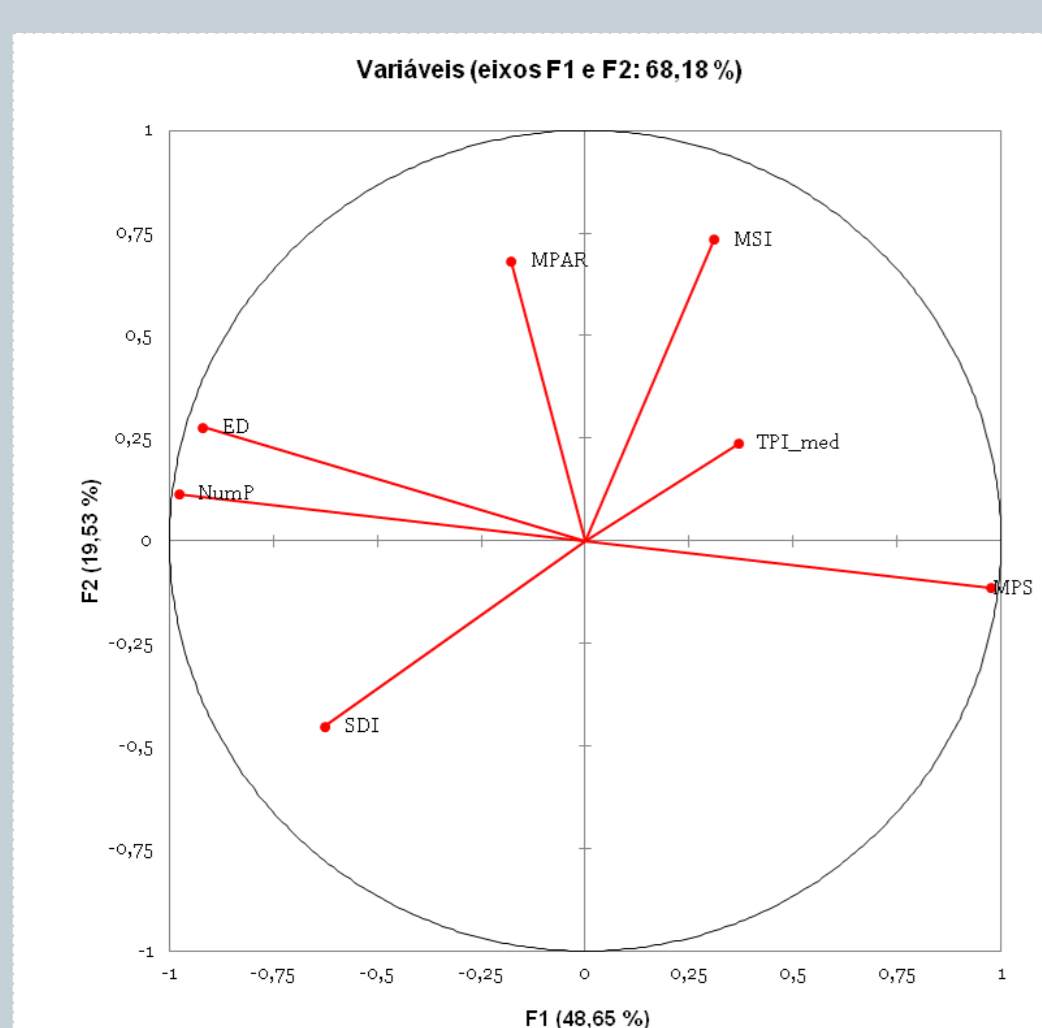


Mean Patch Size (MPS)

Hierarchical agglomerative clustering (HAC)

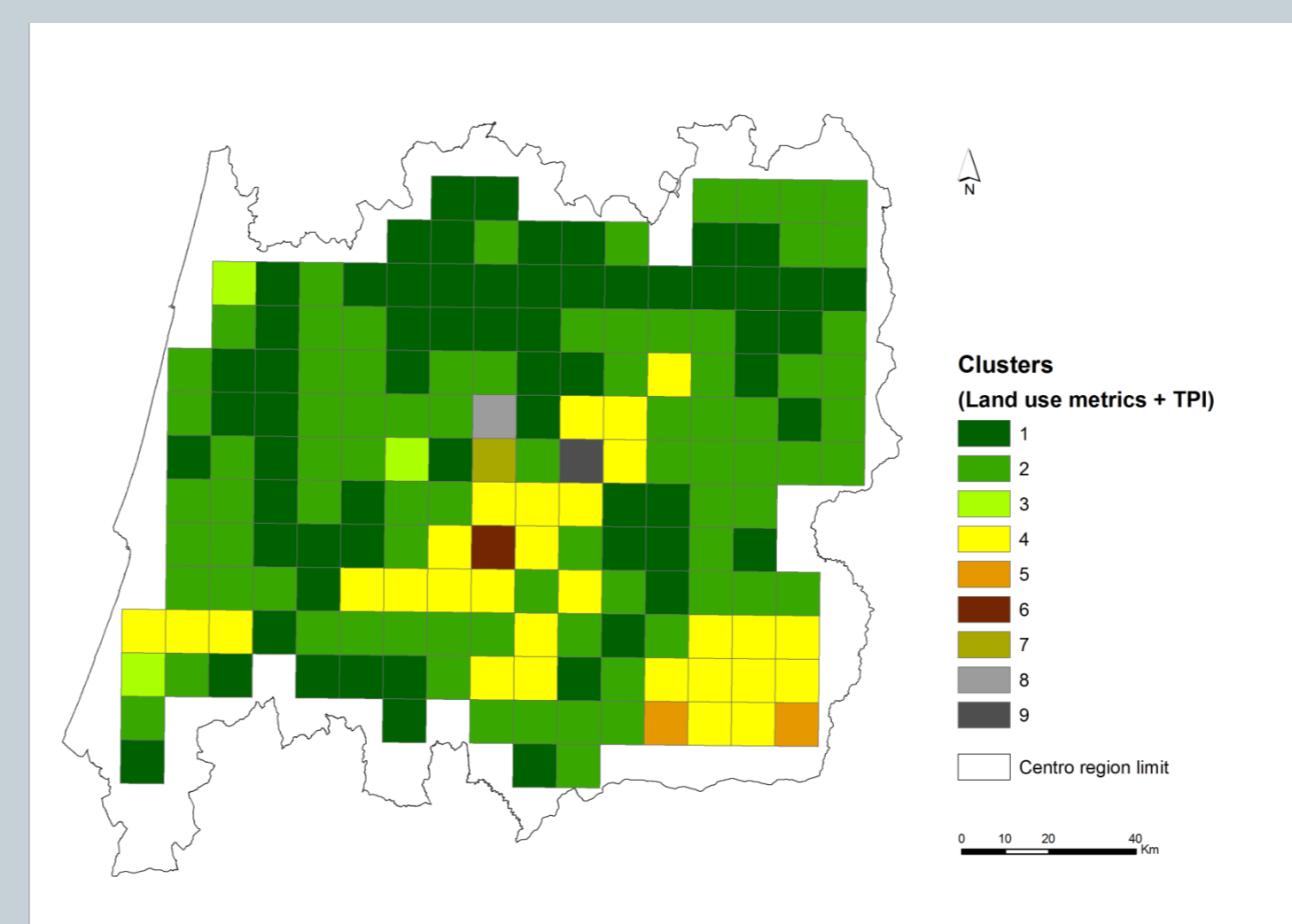


Principal Component Analysis (PCA)

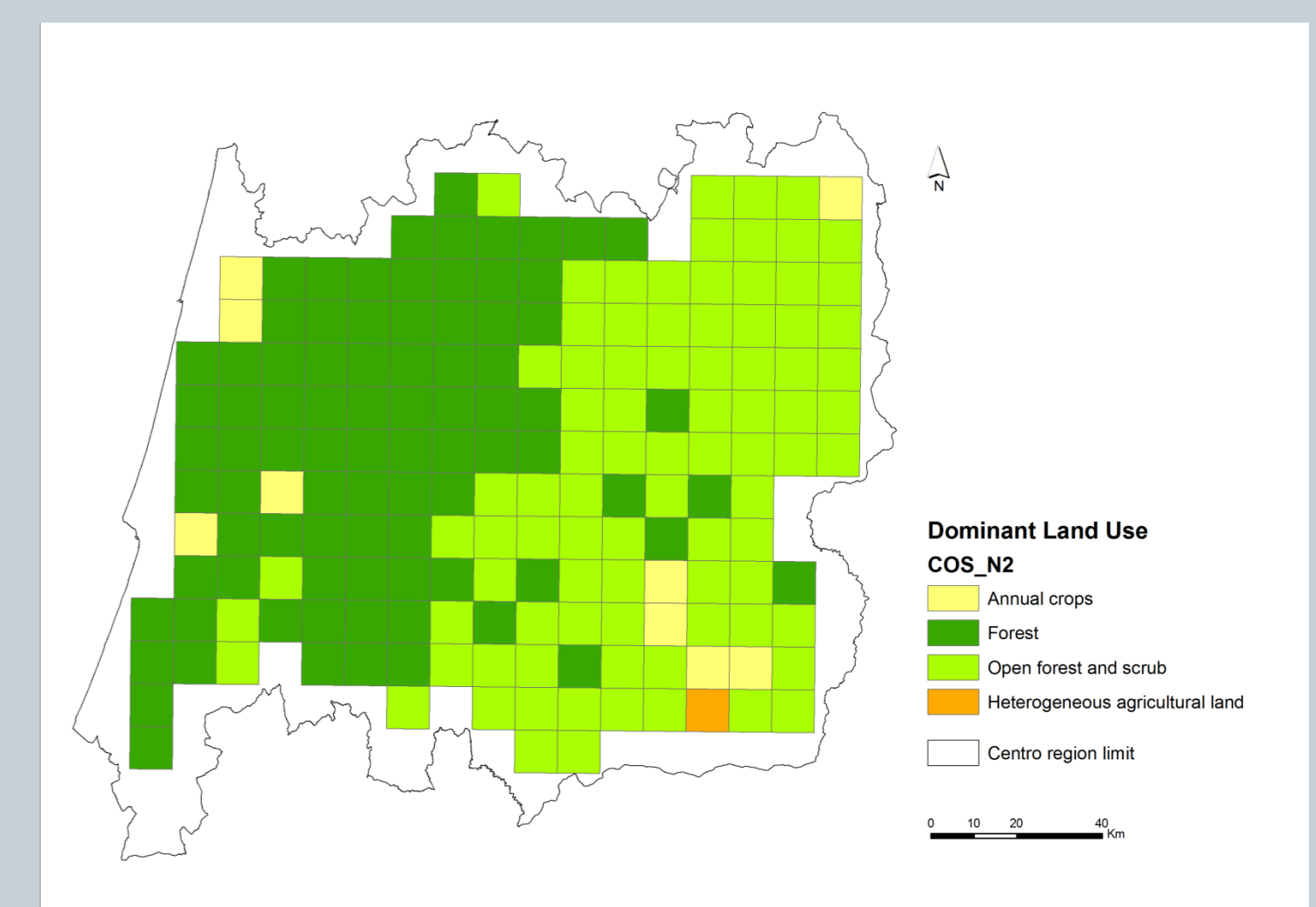


- Cluster 1** - High NumP and low MPS.
High ED and high values of SDI. High TPI.
- Cluster 2** - High NumP and low MPS.
Medium to low values of TPI.
- Cluster 3** - High values of MPAR and low values of TPI.
- Cluster 4** - Low NumP and high MPS.
- Cluster 5** - Low NumP and high values of MPAR.
- Clusters 6 to 9** - No relevance.

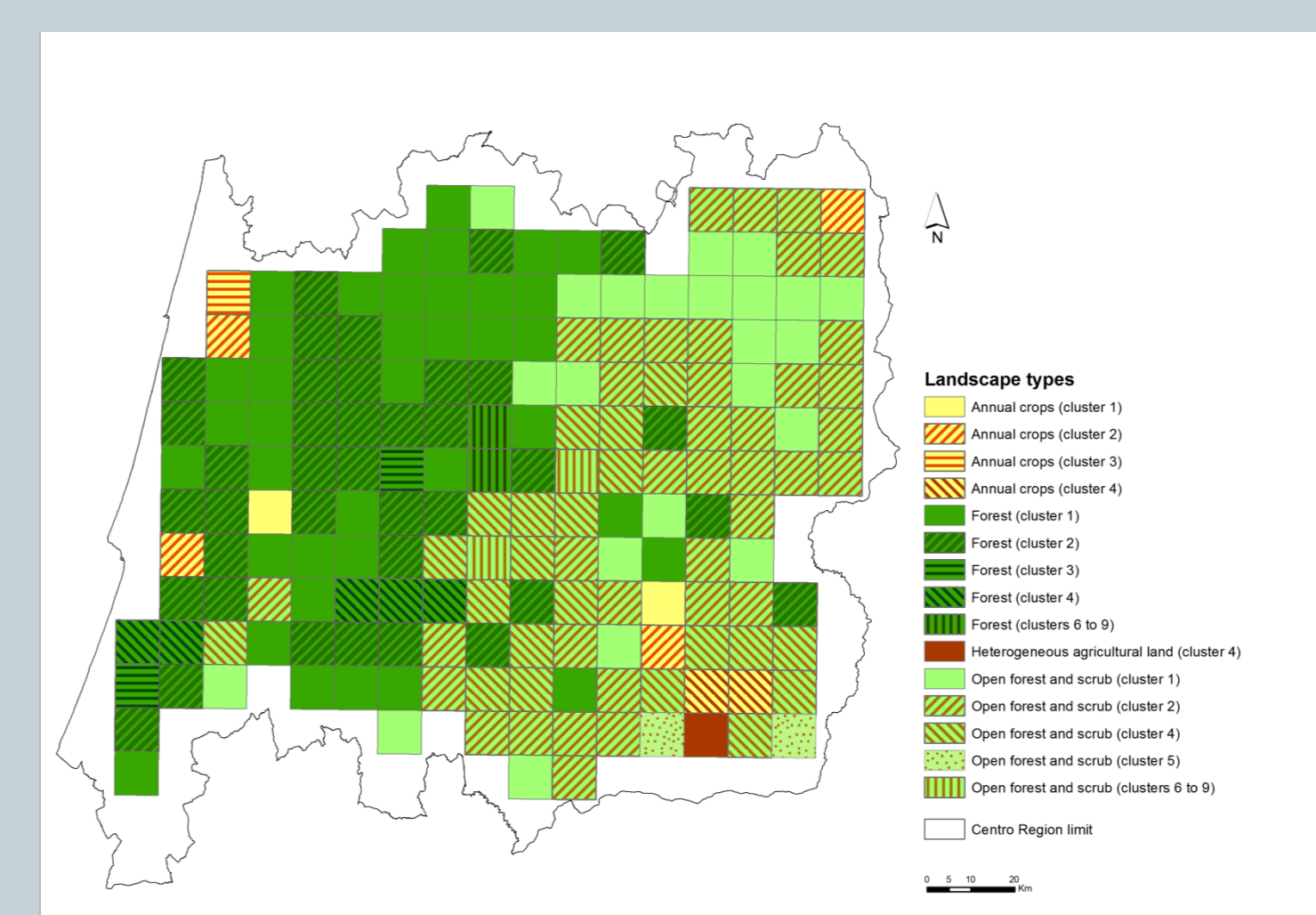
The landscape units map results from the union operation between the clusters' theme and the dominant land use in each grid. The resulting landscape units include land use geometrical properties, topographic types and the dominant matrix.



Clusters (land use metrics + TPI)



Dominant land use (matrix)



Landscape units