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Linking landscape structure and land cover pattern at a regional level

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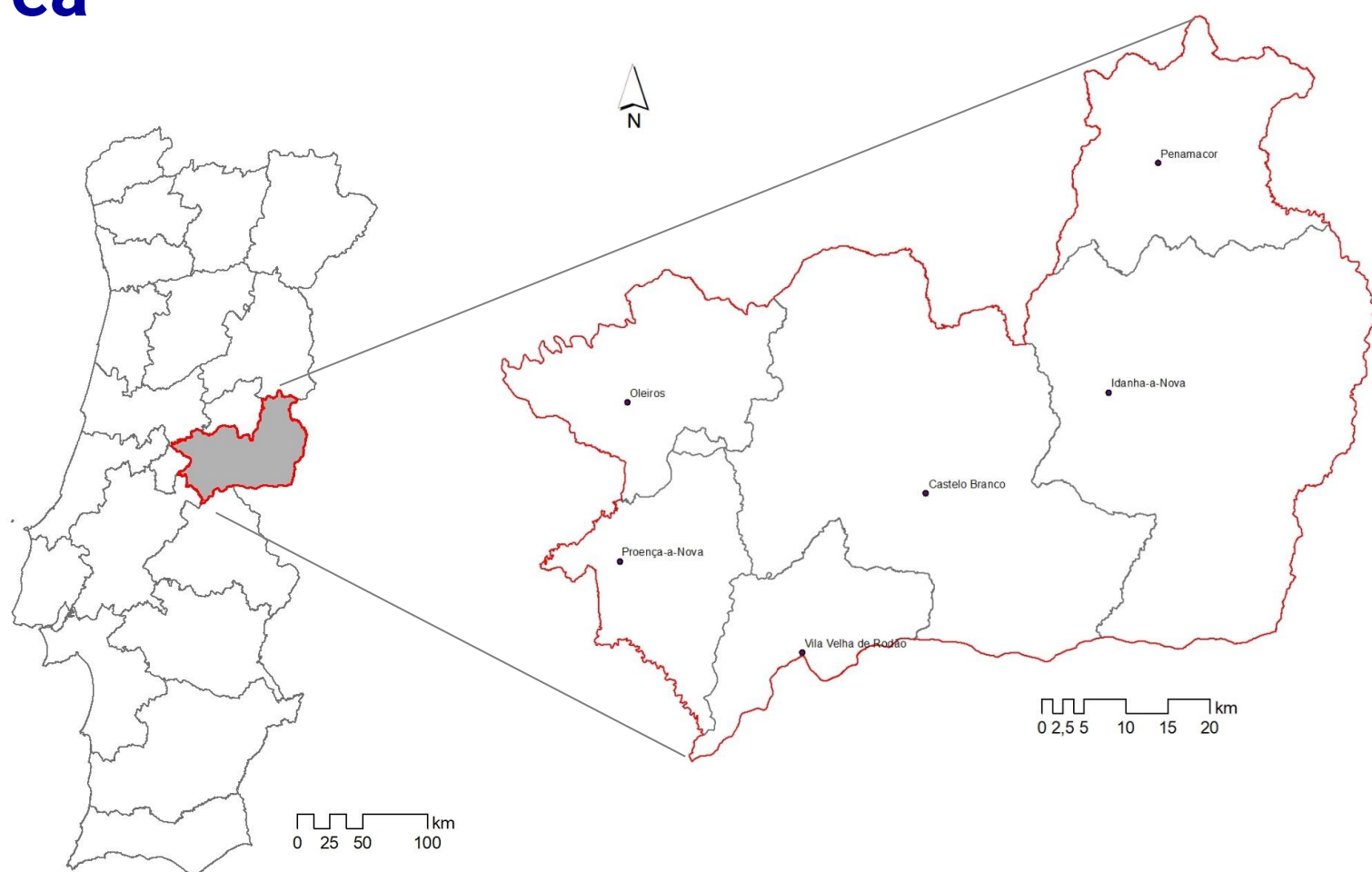
Objectives

The study aimed primarily at defining the potential layer and their **land units** at a regional level resulted from the combination of geomorphology, soil parent material and bioclimatic influence. Subsequently, it is intended to relate the obtained **land units** with the **landscape configuration** extracted from the land use mosaic.

The spatial analysis was performed using **GIS geoprocessing tools**. Landscape configuration was quantified through a wider set of landscape metrics.

A cluster analysis was performed to define groups of samples representing the **land use mosaic types**, and the clusters obtained were analyzed in order to identify **similar geometrical characteristics** and **land use dominant types**.

Study area



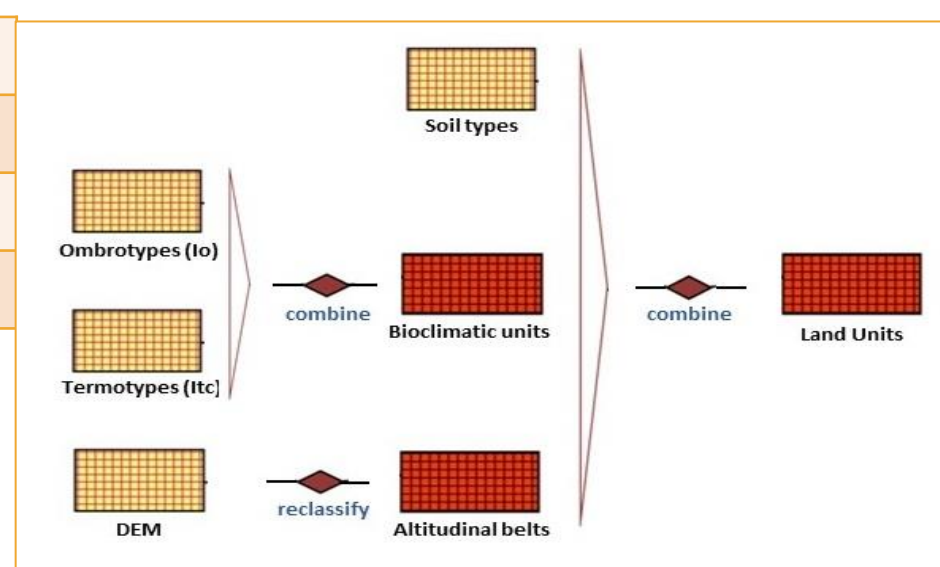
Material and methods

All layers were combined and interpreted using the **ArcGIS 10.8** geoprocessing tools. The Land Units Map was obtained by overlaying the thematic maps representing the main physical factors, namely soils, bioclimatic units, and elevation.

Spatial data sets:

Digital Elevation Model - Shuttle Radar Topography Mission
Bioclimatological indices maps (Io / Itc)
Map of soil parent material types
Land Cover Map COS2018

Spatial model:



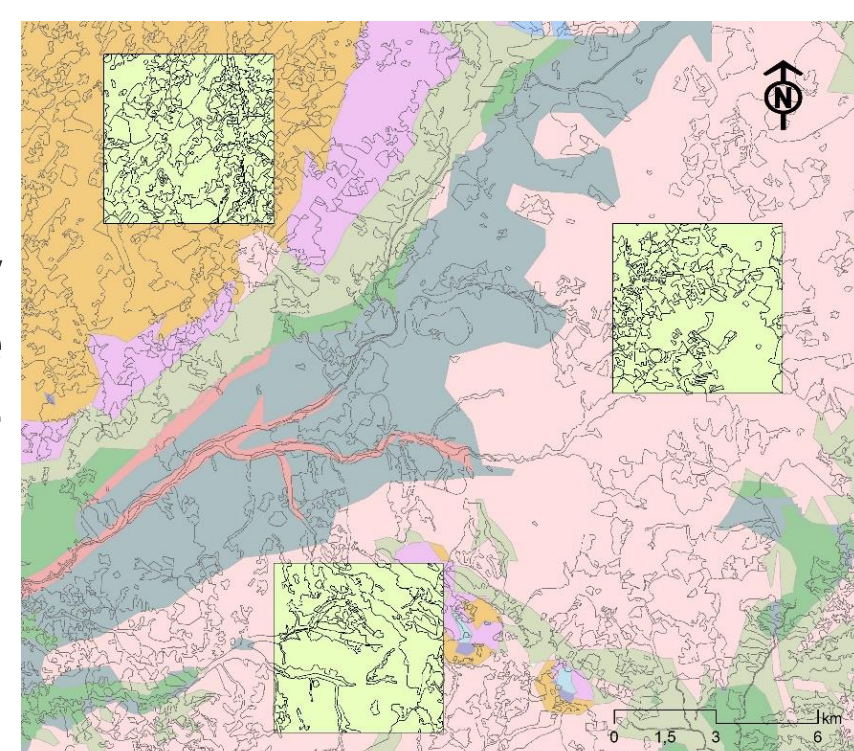
Land Use Mosaic geometry was analyzed using **Patch Analyst extension** from **ArcGIS 10.8** on the Land Cover map, characterizing its composition and configuration. This extension includes measures related to patch complexity, configuration, and landscape diversity.

Landscape composition of each sample area (5 km²) representative of each Land Unit was quantified by the percentage of area occupied by each land cover class. Landscape configuration was quantified through a wider set of metrics.

Statistics describing the distribution of patch area such as **Number of Patches (NumP)** and **Mean Patch Size (MPS)** were computed as they provide central tendency. **Patch Density (PD)**, **Edge Density (ED)** and **Mean Shape Index (MSI)** provide indications on the fragmentation degree of the different land cover types.

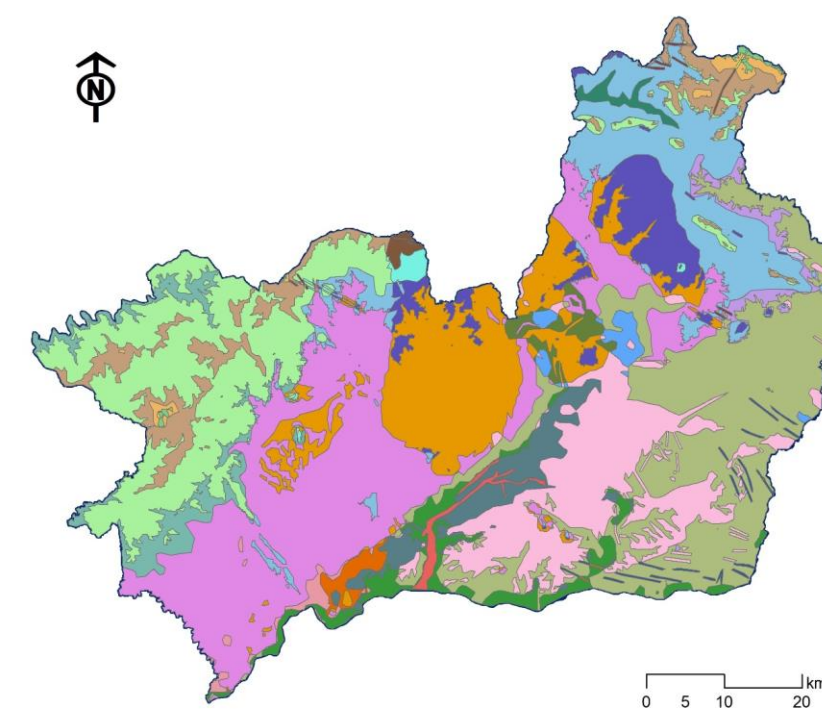
The relative diversity of land cover classes within sample areas was determined using **Shannon's Diversity Index (SDI)**.

These metrics were chosen due to their widespread use in landscape analyses and well-documented effectiveness in quantifying spatial patterns.



Results and discussion

The resulting **Land Units Map** of Beira Baixa region has **26** homogeneous units representing combinations of main stable environmental factors that constrain the circumstantial structure of the landscape.

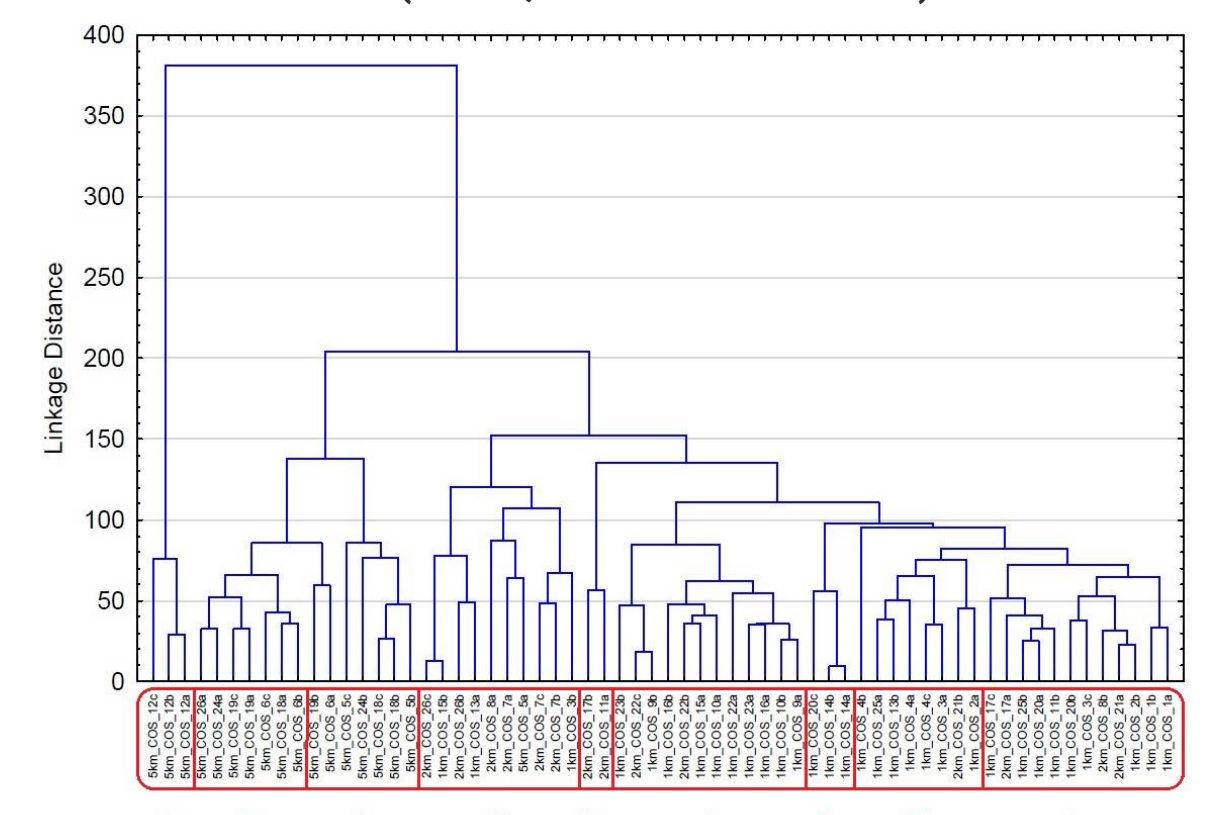


Values of the landscape metrics
(average per Land Unit).

Land Unit	SDI	MSI	MPAR	ED	MPS	NumP
1	1.45	1.93	464.90	246.59	6.87	18.00
2	1.52	1.71	582.23	199.06	7.28	32.00
3	1.14	1.86	7990.40	147.18	21.37	7.67
4	0.95	2.08	598.94	179.35	14.47	8.33
5	1.61	1.82	871.19	105.94	29.56	92.33
6	2.23	1.71	570.07	181.60	9.56	264.33
7	0.83	1.68	2220.38	81.59	43.89	12.33
8	1.76	1.63	449.17	185.06	8.84	29.50
9	0.69	1.68	641.77	124.88	12.98	9.50
10	0.93	1.86	310.59	149.70	15.02	8.00
11	1.68	1.81	593.91	239.15	6.14	50.00
12	2.55	1.69	547.71	232.92	5.91	425.67
13	0.89	1.72	291.05	126.67	24.50	10.00
14	0.68	2.48	366.12	158.25	22.04	5.50
15	0.66	1.44	587.37	92.97	50.22	8.00
16	0.99	1.75	686.64	135.10	15.74	10.50
17	1.44	1.80	592.30	224.65	6.41	54.67
18	2.13	1.82	334.17	147.82	16.03	164.00
19	1.66	1.80	655.73	173.08	11.40	225.00
20	1.54	1.84	740.05	197.13	9.18	25.33
21	2.15	1.70	392.08	210.01	6.60	32.50
22	0.91	2.08	753.65	140.32	21.63	19.33
23	0.58	1.92	4328.29	92.93	32.09	7.50
24	1.18	1.80	400.50	143.60	15.13	180.50
25	1.66	1.71	637.96	190.03	7.44	25.50
26	1.17	1.74	1124.92	96.02	41.47	81.00



Cluster analysis - all samples
(UPGA, Euclidean distances)



Cluster analysis: Land Units (permanent structure) vs. Land Use (circumstantial structure)

- Cluster A:** Rock types/formations very rich in silica in Basal belt under the influence of Mesomediterranean dry climate
Diversified mosaic with high diversity of land uses. No dominant use. High ED. High NumP and SDI
- Cluster B:** Rock types/formations rich in silica in Basal belt under the influence of Mesomediterranean subhumid climate
No dominant use. High to medium SDI. High to medium NumP. High to medium ED.
- Cluster C:** Rock types/formations rich in silica in Basal belt under the influence of Mesomediterranean dry climate
No dominant use. High to medium SDI. Medium ED.
- Cluster D:** Rock types/formations very rich in silica in Basal belt under the influence of Thermomediterranean dry climate
Quercus sps. "Montado" and annual crops dominance. Low to medium SDI. Low ED.
- Cluster F:** Matrix of Rock types/formations rich and poor in silica in Basal belt under the influence of Mesomediterranean dry climate
Pine tree Forest and scrubland dominance. Low to medium SDI. Low ED and NumP.
- Cluster G:** Rock types/formations very rich in silica in Basal belt under the influence of Thermomediterranean dry climate
Holm oak woodland dominance. Low SDI. High MSI. Medium ED. Very low NumP.
- Cluster H:** Rock types/formations moderately rich in silica in Basal belt under the influence of Mesomediterranean subhumid climate
Quercus sps. "Montado" and pasture dominance. High SDI. Medium MPS. Low NumP.
- Cluster I:** Alluvions in Basal belt under the influence of Thermomediterranean dry climate - Rock types/formations rich in silica in Basal belt under the influence of Mesomediterranean humid climate - Rock types/formations rich in silica in Basal belt under the influence of Thermomediterranean dry climate
Scrubland dominance. Medium MSI. Low MPS values. Medium NumP.

Conclusions

- It can be concluded that there is a close relationship between land units and land use pattern in terms of dominance and configuration.
- The landscape metrics that best explain the influence of the permanent structure of the territory on the circumstantial structure of use are Shannon's Diversity Index (SDI), Edge Density (ED) and Number of Patches (NumP).
- The delimitation and characterization of homogeneous land units are useful for the definition of soil suitability and for the choice of the most appropriate uses and activities by the stakeholders.