SPATIAL DELINEATION OF SUBURBAN AREAS: THE CASE OF LITHUANIA

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The concept of ***regionalization*** can be used in different contexts, e.g. natural, economic, social, cultural.

Regionalization is the division of a certain territory into smaller territorial units, taking into account the main characteristics of the subject and related phenomena, and it aims to discover and generalize similarities covering more than one phenomenon dimension, including territorial contiguity.

Regionaliztion is the selection of districts (territorial clusters) in which the main characteristics of the phenomenon can be equally summarized, it creates a statistical profile of the district.

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There is no official concept that precisely defines what is considered **a big city in Lithuania.**

The law on administrative units of the territory of the Republic of Lithuania and their boundaries clearly defines ***the concepts of cities, towns, villages and settlements***:
- cities are compactly built residential areas with more than 3 thousand of the population, of which more than 2/3 of employees work in industry, business, and the fields of production and social infrastructure exist.


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The term ***suburb*** is not officially defined, so there are often different interpretations of what is named as a suburb.

The definition in the Universal Lithuanian Encyclopedia defines that suburb is
the outskirts of the city; a settlement near the city

The English term suburb is defined similarly. The Cambridge Dictionary defines it as
an area on the outskirts of a large town or city, often inhabited by people who work in the town or city

However, exact criteria are not distinguished, as in the case of cities or towns, how to determine suburban territories. For this reason, suburbs are often interpreted differently not only in different countries, but also within the same state.

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After analyzing the latest researches related to regionalization, the analysis of the conducted research and the very interpretation of the concept of regionalization reveal that there are certain common features.

According to J. C. Duque, R. Ramos, J. Suriñach (2007) in the article on ***Supervised Regionalization Methods,*** there were identified ***5 essential features*** of all regionalization methods:

1. All methods combine geographic areas into a certain number of regions by optimizing a specific aggregation criterion;
2. Areas of the region must be geographically linked (spatial contiguity);
3. The number of regions must be less than or equal to the number of areas;
4. Each area can be assigned to only one region;
5. Each region must have at least one area.

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It is difficult not only to define (name) what a suburb is, but also to distinguish the suburban territories of different cities.

There are no clear official rules as to what is considered a suburb, so this research conducts a generalized data analysis that allows at least a partially objective assessment of suburban areas.


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Much of the methodology used to delineate suburban areas is similar for all three major cities in Lithuania.

The primary territory is formed and data selection takes place:

- address points of the Address Register;
- OpenStreetMap building and road layers;
- in 2021 population and housing census data;
- 100x100 m grids.

The following actions are performed on the selected data:

- the density of address points is calculated using the *kernel density tool*;
- population density is calculated using the *kernel density tool*;
- road density is calculated using the *kernel density tool*;
- the *density of buildings* in 100 m grids is calculated. In this case, it is estimated what part of the grid is occupied by buildings (from 0 to 100 %).

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The suitability modeler is carried out, which allows the analysis results to be combined into one raster.

The use of raster data is required for suitability modeler, so grids with estimated building density are converted to a raster data layer with values equal to the values of the fraction of buildings in the grid. It is important to mention that all data analysis is performed in 100x100 m grids. All 4 rasters are used in the suitability modeler environment.

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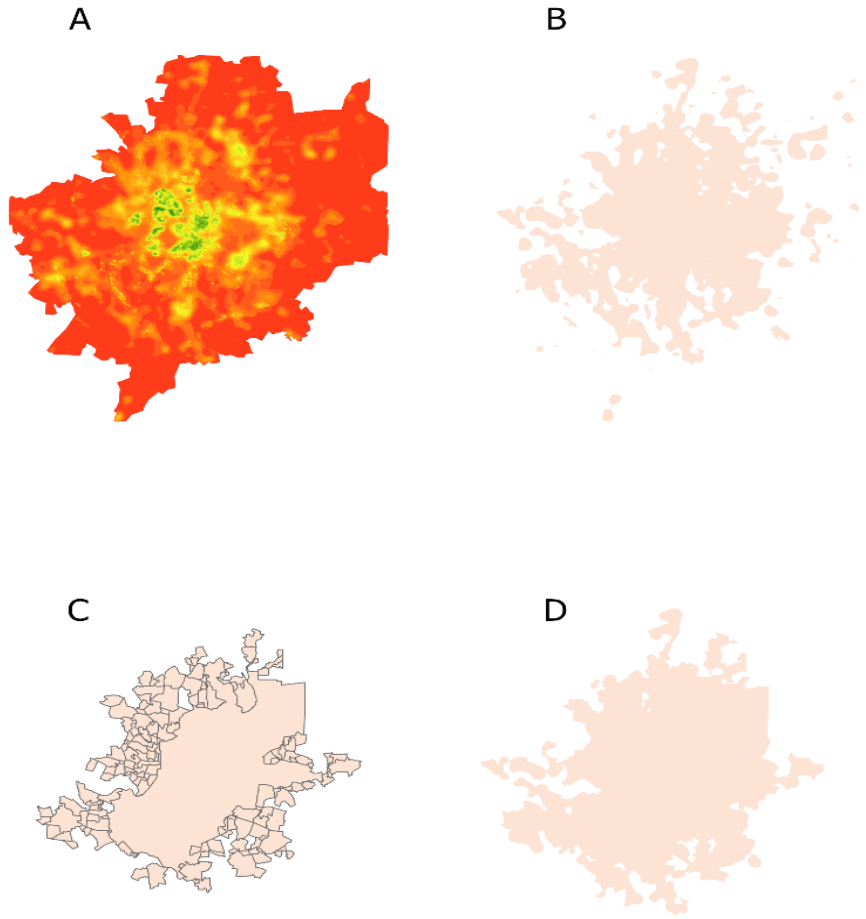
32 elderships were selected from all the elderships of the city and district of Vilnius



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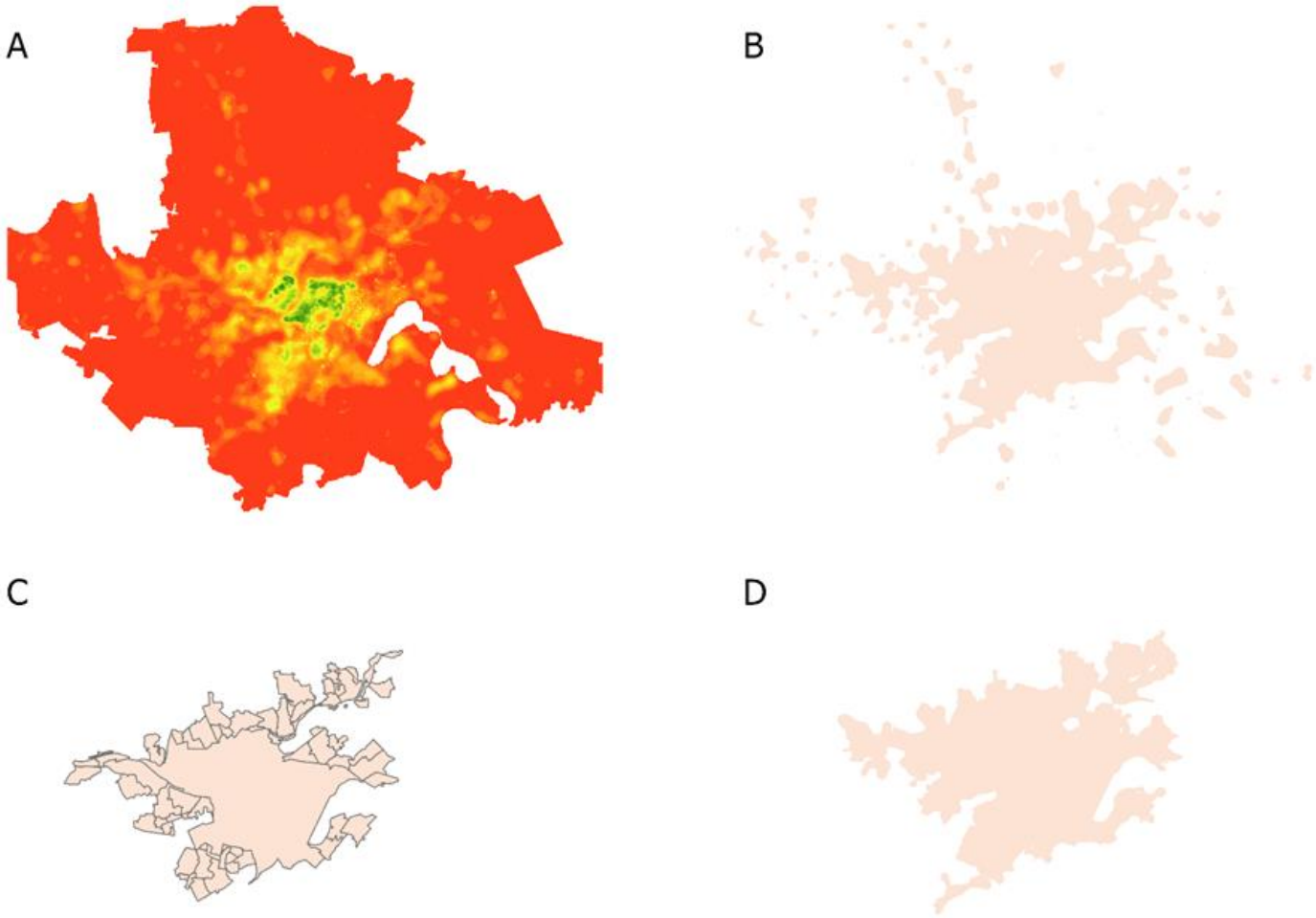
33 elderships were selected from all the elderships of the city and district of Kaunas



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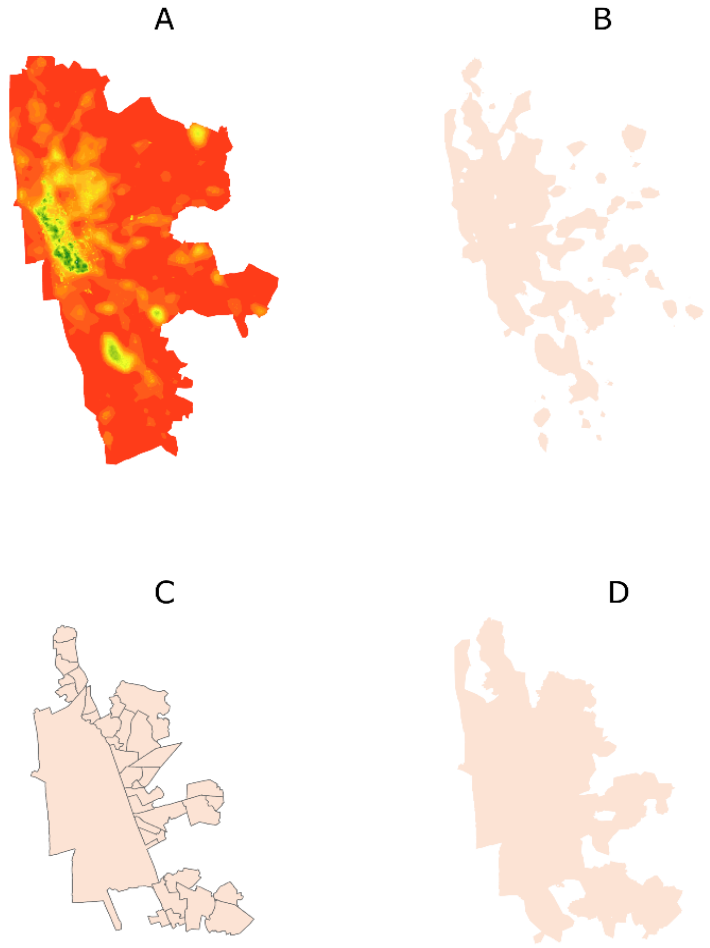
5 elderships were selected from all the elderships of Klaipėda district. The peripheral territories of the city of Klaipėda up to the Palanga highway are also assigned.



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The series of experiments carried out in the study uses 3 spatial clustering methods, selected after analyzing the literature and software capabilities.

1. ***SKATER*** (Spatial Cluster Analysis by Tree Edge Removal). This method is based on minimal spanning tree. Each object has its own vertex and is connected to its neighbors (adjacent objects) by edges. In this case, the weight of an edge is important, which is proportional to the difference between the objects it connects, and here the difference is measured by the attribute values of the neighbors.

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2. ***REDCAP*** (Regionalization with dynamically constrained agglomerative clustering and partitioning). Optimal tree cuts up to the desired number of clusters are obtained.

3. **AZP** (Automatic Zoning Procedure). It is one of the oldest zoning methods, which has been partially used for a long time as one of the ways to solve the Modifiable Area Unit Problem (MAUP). The method is based on a heuristics, which is designed to find the best combination of adjacent spatial units, dividing them into a certain number of regions.

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REDCAP method. Settings: method - FullOrder-WardLinkage; minimal bound – not specified; minimum region size (min region size) – not specified; distance function – Euclidean; transformation method - raw. Between-group sum of squares and total sum of squares ratios:

- Vilnius = 0.585489.
- Kaunas = 0.632799.
- Klaipėda = 0.71797.

SKATER method. Settings: minimal bound - not specified; minimum region size (min region size) – not specified; distance function – Euclidean; transformation method - raw. Between-group sum of squares and total sum of squares ratios:

- Vilnius = 0.515888.
- Kaunas = 0.585062.
- Klaipėda = 0.695279.

AZP method. Settings: method - AZP; arisel - not selected; minimum limit - not specified; minimum region size - not specified; initial regions (English initial regions) – not specified; distance function – Euclidean; transformation method - raw. Between-group sum of squares and total sum of squares ratios:

- Vilnius = 0.531971.
- Kaunas = 0.674967.
- Klaipėda = 0.679281.

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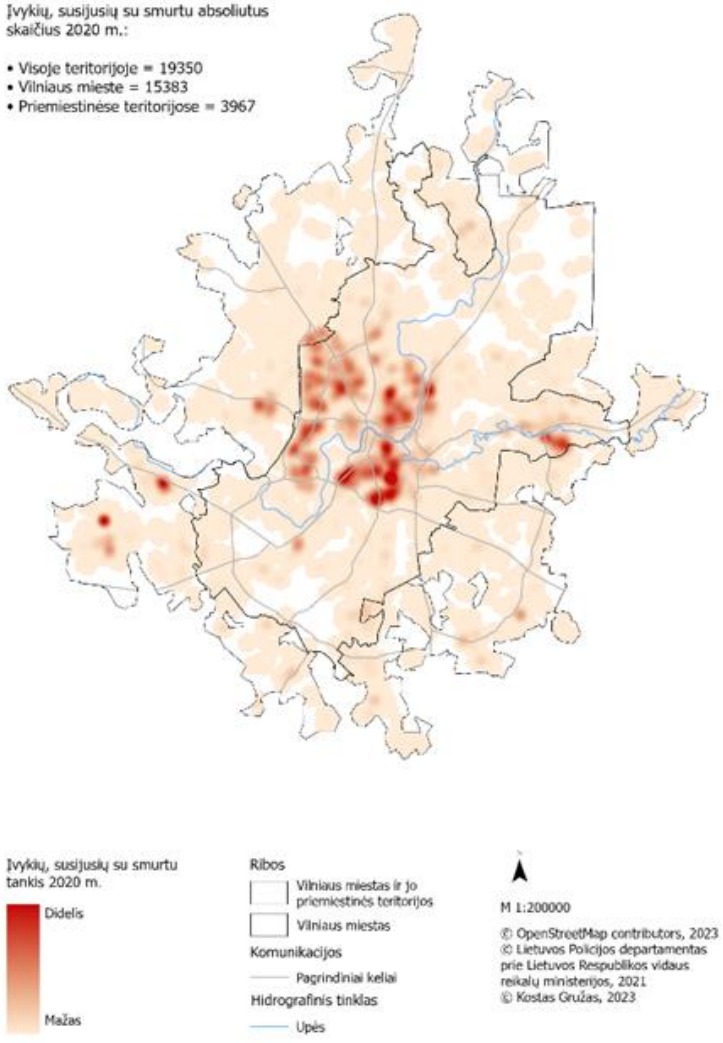

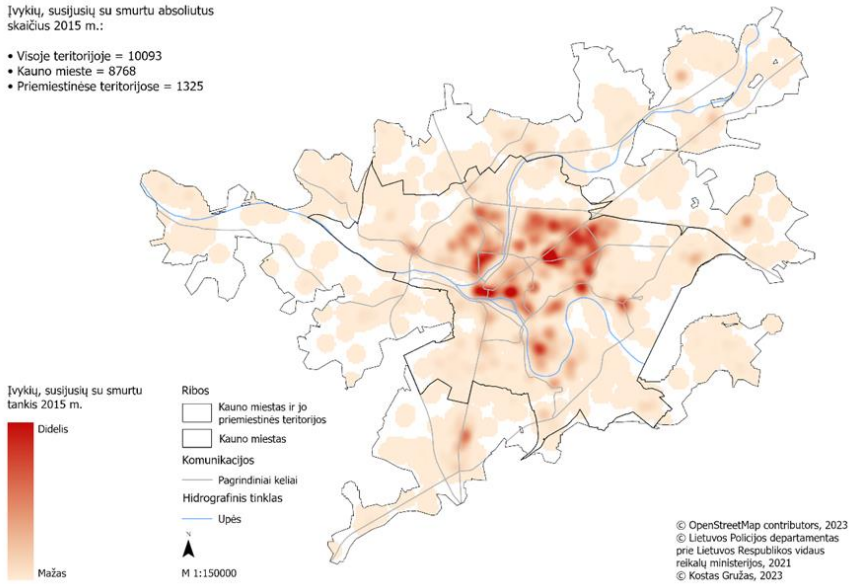

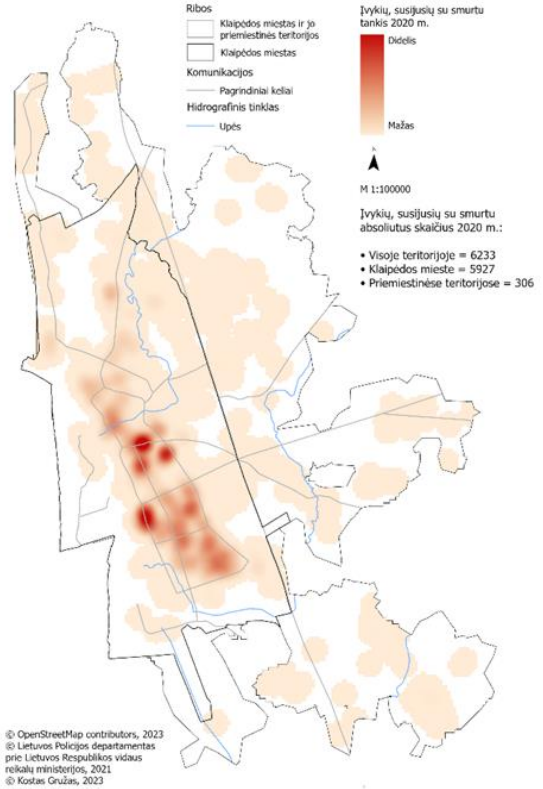

Klaipėdos universitetas

Thank you for your attention !

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