BOOK OF PROCEEDINGS

2nd INTERNATIONAL CONFERENCE ON HOUSING, PLANNING, AND RESILIENT DEVELOPMENT OF THE TERRITORY

TOWARDS EURO-MEDITERRANEAN PERSPECTIVES

OCTOBER 16th-17th, 2025

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2nd International Conference on Housing, Planning, and Resilient Development of the Territory

Towards Euro-Mediterranean Perspectives

Conference Theme and Rationale

This conference returned for the second time within the Albanian and Mediterranean academic context, aiming to build a tradition of collaboration centered on scientific research and academia. Following the success of the first edition held on October 13th-14th, 2023, where proceedings were published in the Book of Proceedings, Albanica journal, and various international academic platforms, POLIS University and the Academy of Sciences of Albania relaunched this important event. The 2025 edition focused on housing, urban planning, and resilient territorial development, offering a platform for researchers, policymakers, and experts from the region and beyond.

Albania and the Western Balkans have faced major transformations in urbanization, spatial planning, and environmental management. Demographic changes, economic pressures, and environmental challenges created a need for new strategies in architecture, planning, and governance. This conference brought together diverse voices to explore these themes and promote resilient and sustainable development.

Key topics included architecture and the city, with emphasis on urban form, housing typologies, and the role of cultural heritage in modern urban design; urban mobility, addressing traffic challenges, public transport, and the use of technologies like GIS and AI in planning; and new housing models, focusing on affordability, energy efficiency, and innovative materials.

Discussions also covered demography and economy, exploring territorial governance, smart cities, social enterprises, and digital technologies such as AI, VR, and the Metaverse in urban management. Finally, the urban and natural environment was addressed through topics like pollution, adaptive planning, and nature-based solutions for climate resilience.

Through this conference, POLIS University and the Academy of Sciences of Albania aimed to foster a broad interdisciplinary debate on these pressing issues, combining academic and practical perspectives to offer concrete recommendations for future urban and territorial development policies and projects.

Organizers' Announcement

The International Scientific Conference on Housing, Urban Planning, and Resilient Territorial Development: Toward Euro-Mediterranean Approaches was held on October 16th-17th, 2025, in Tirana, Albania. Organized by POLIS University in collaboration with the Academy of Sciences of Albania and supported by national and international partners, including the University of Ferrara and Co-PLAN, Institute for Habitat Development, the event brought together researchers, academics, policymakers, and professionals to address key challenges in urban development, with a focus on resilience and sustainability in the Euro-Mediterranean region. The first day of the conference took place at the Academy of Sciences, while the second day was hosted at POLIS University.

The conference explored five main themes:

I. Architecture and the City, which investigated the typological and morphological dimensions of urban form, the evolution of collective and individual housing types, the relationship between architectural design and urban identity, and the role of historical and cultural heritage in shaping contemporary cities;

II. Urban Mobility and Resilient Cities, which addressed traffic congestion, infrastructure challenges, and public transportation, while also promoting the redesign of public spaces – such as streets, squares, and pedestrian zones – to improve accessibility and mobility; it also explored the integration of digital technologies like GIS, AI, and simulation tools to enhance planning, automation, and infrastructure management;

III. New Housing Models, which examined innovative approaches to affordable and social housing in response to demographic shifts and technological change, along with energy efficiency strategies, passive energy systems, and the application of new sustainable materials and construction technologies;

IV. Demography and Economy, which focused on macro-regional and national dynamics impacting territorial development, including urban governance, disaster risk reduction, and the rise of smart and inclusive cities; it also explored how emerging technologies – such as AI, VR, and the Metaverse – along with social enterprises and circular economy practices, could foster more equitable and adaptive urban systems; and

V. Urban and Natural Environment, which analyzed environmental degradation in urban settings, including air, water, and soil pollution, and promoted nature-based solutions, ecosystem-based planning, and adaptive strategies to enhance environmental sustainability and climate resilience.

The conference was conducted in English and Albanian (with self-translated texts where applicable) and was free of charge, with all registration fees fully covered by POLIS University in support of open academic exchange. Key deadlines included abstract submission by June 15th, acceptance notification by June 30th, first draft of papers by September 15th, and final submissions by October 31st.

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Circular and regenerative economy practices in the Western Balkans / Implementation of the Green Agenda for the Western Balkans: challenges and opportunities for resilient communities.

Mapping the Invisible Boundaries

A Data-Driven Approach to City Delineation

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Abstract

According to estimates, 67% of the world's population is expected to live in urban and sub-urban areas by 2040, primarily due to ongoing migration from rural areas. This pattern is also very noticeable in Albania, where a highly populated metropolis that frequently stretches beyond its administrative borders is the result of rapid urbanisation.

For a long time, researchers and policymakers have struggled to define urban areas. Some of the traditional methods rely on administrative borders, which often fail to capture the actual economic and spatial dynamics of cities. Others depend on urban morphology, missing the population behaviours and needs. To better understand and manage the urban dynamics, this research aims to try a different method for calculating Tirana's borders. This method will be based on population distribution, utilising a density-based clustering technique in conjunction with a digital representation of the urban form. In comparison to the original administrative boundaries, can a digital, data-driven, density-based algorithm provide a more functionally correct and policy-relevant delineation of metropolitan areas in a mid-sized city like Tirana? And how can we encode the urban morphology in a digitalised representation that can be both fed into an algorithm and understood by urban planners?

This project aims to develop a machine learning-based approach that clusters buildings into urban zones defined by metrics such as density, urban morphology, and geographic distribution. This approach will lead to the identification of a group of strongly interconnected urban clusters that better represent the physical environment and distribution of economic activity in Tirana. These groups will reflect the real functional extent of the city, taking into account its urban form, and excluding low-density, outlying zones. Additionally, we believe that the vertical land indicator will

provide fresh perspectives on Tirana's urban polycentricity and compactness, which will influence the design of spatial policies and infrastructure development.

These newly drawn lines will serve as a foundation for further study, enabling more accurate plans for sustainable development, more focused urban planning, quick detection and reaction to change, as well as novel opportunities for economic analysis and policymaking.

Keywords

Rapid urbanisation, clustering, urban, machine learning, density

1. Introduction

In the age of rapid urbanization, understanding the spatial limits of urban areas has become an essential task for both researchers and policy-makers. But how should a city boundary be defined?

Defining urban areas has long been a challenge in urban studies since traditional approaches often rely on administrative boundaries that do not adequately capture an accurate geographical and functional composition of cities. This paper addresses the challenge of defining Tirana's true urban extent through a data-driven delineation model that integrates building-level information and spatial clustering.

As cities from time to time transcend their formal boundaries, they result in continuous urban landscapes that are not adequately represented by administrative division. (Daniel Arribas-Bel) An alternative approach to address this issue is to define urban areas based on building density and land use characteristics.

Most of the available data is at the level of local political or administrative units and these statistics have proven problematic because of the uneven distribution of population and economic activity, as well as the differences in land size and land use within these units. Unfortunately, policy-making often occurs at the level of administrative zones, but, again, these areas generally fail to reflect functional reality and may even negatively affect subsequent policies (Daniel Arribas-Bel, 2021).

Instead of depending on administrative or municipality unit, this study uses building-level data to define urban zones in Tirana, Albania, utilizing a data-driven methodology. We use a density-based clustering algorithm to classify buildings into continuous urban zones according to a build-up intensity and spatial proximity. By removing the arbitrary divisions established by legal limits, this approach offers a more functional and organic image of the city. The study's objective is to develop and test a computational method capable of identifying functionally coherent urban zones based on density and morphology, compare the delineated boundaries with official administrative zones, and assess the potential of such digital delineations to inform sustainable planning and infrastructure policies.

Better urban planning and policy decisions may be supported by the findings, which provide a more accurate understanding of urban form, density distribution and economic activity patterns. This approach highlights developed areas, on which further analysis can be conducted, while at the same time identifying underdeveloped areas, serving as a basis for designing policies aimed at their development.

Things to be considered:

- Can this methodology help in predicting urban growth?
- Since now the separation is been made by data-driven methodology is it easier to make comparisons based on some aspects between urban areas, also characterize land use changes?
- How can we encode the urban morphology in a digitalized representation that can be both fed into an algorithm and understood by urban planners?

This paper discusses the applied technique, the results and how this approach varies from standard administrative delineations. The study contributes to ongoing debates in spatial and smart-city governance, by highlighting these objectives explicitly, positioning Tirana as a representative case for mid-sized Mediterranean cities facing informal growth and blurred boundaries.

2. Literature review

2.1. The importance of delineating urban areas

Before examining specific algorithms used, it is needed to say that urban delineation techniques have evolved from morphological interpretations to computational and data-driven models. Early approaches relied on land-use or administrative boundaries, whereas current research increasingly employs machine learning and big-data sources to capture the functional reality of cities. This takes special significance in Albania due to the extensive development in recent decades, related to the change of the economic and political system after 1990.

Metropolitan areas like Tirana are investing in capital projects to improve their infrastructure and amenities, which has caused uneven urbanization and disproportionate population increase, ultimately compromising social and economic sustainability, mentioned by Arpita Bakshi (2023).

Urban administrative division always remains a problem especially for urban economist. According to Arribas-Bel et al., one of the main challenges faced by urban economists, along with the lack of data, is how to define a city (2021). Administrative areas are often used for policy-making purposes, and such areas usually do not reflect any functional reality and can even compromise the effectiveness of the resulting policies.

There are two main reasons that makes defining the boundaries of urban areas important.

First, existing administrative units, such as municipalities, generally do not constitute independent and functionally autonomous units. Second, improperly defined units can lead to a number of biases related to MAUP problem (Xi Li, 2021).

In their study on urban land use planning, Chaturvedi and de Vries (2021) noted that mapping the temporal and spatial changes of urban and rural land is very important to highlight the effects of human activity on the environment. Therefore, delineating urban areas remains a challenging task to support the daily practices and the spatial-temporal needs of planners and decision-makers.

Furthermore, the way how urban areas are defined, directly influences the statistics used in urban analysis, which in turn shapes the conclusions drawn regarding urban dynamics and development (Chenyu Fang, 2025).

Chinese researcher Yixing Zhou argues that the scientific definition of cities is essential in conducting urban scientific research and achieving sustainable development of cities and regions.

For planners and geographers, defining city borders is always an intriguing challenge. To effectively govern and manage cities (count populations, impose taxes, set up transportation systems, etc.), planners need to know where cities begin and end. Geographers also need to know the city limits in order to map urban growth, describe changes in land use, compare cities (in terms of area and population), etc.

2.2. Methodologies and algorithms used for delineating urban areas

- Arribas-Bel et al. (2021) - The authors contribute by developing a new methodology for determining urban areas. By relying on a unique database on the precise geolocation of all 12 million buildings in Spain, they design a density-based machine learning algorithm to group buildings within areas of sufficient density.
- Chenyu Fang (2025) - This paper aims to develop a methodological approach for data-driven cities that harnesses the power of OSM data to redefine urban areas. Specifically, the study aims to improve the accuracy of urban area definition by filtering and clustering relevant OSM data, explore the applicability of DBSCAN clustering in defining urban features and boundaries, and evaluate the performance of the proposed method through validation with external datasets, such as night-time light data and Zipf's law.
- Xiaomeng Sun (2023) - The study aims to define peri-urban areas using data from various sources and automatic learning, as well as including information regarding human movement. In particular, we use datasets of land use and land cover (LULC) maps, night light images, points of interest (POI), the road network, and taxi trajectories.
- Dabove, Daud, & Olivotto (2024) - The footprints of buildings are essential in urban planning. In the context of urban planning, they provide valuable insights into the distribution of buildings, facilitating the efficient use of land and development strategies. The paper proposes a new method to address the challenges of segmenting building footprints in urban environments.
- Hanoon et al. (2023) - Land use optimization approaches are a powerful strategy to maximize the advantages in urban land use planning. This study aims to bring a simple technique that can predict urban sprawl over the long term, while easily integrating with land use optimization techniques to make appropriate decisions. It presents urban growth boundaries (UGB) as a simple tool to manage urban sprawl.
- Ghaffarishahri (2022) - The definition of the boundaries of Historic Urban Areas is considered an important part of urban planning. However, for a long time, the official demarcation of the boundaries of Historic The study aims to develop a digital and semi-automated approach for the rapid definition of the boundaries of historic urban areas. To

achieve this goal, a data-driven and structured method for the characterization of urban areas is required, based on Graph Theory and Graph Neural Networks.

- Moreno-Monroy et al. (2021) - The paper presents a new method to define metropolitan areas - or functional urban areas (FUAs) - worldwide and assesses their population trends. This paper contributes by proposing a method to uniquely identify commuting areas around urban centers. The commuting areas around each urban center are approximated based on the estimated probability that grid cells of one km2 outside urban centers belong to a metropolitan area.

Overall, all the studies mentioned above demonstrate the variety of methods utilized to define urban and suburban areas, each providing special benefits and solutions for urban planning and research.

3. Methodology

The process of grouping a given collection of data objects into clearly separate sets or groups is known as cluster analysis or clustering. All the items in a set are similar with each other; as a result, items in various sets are not the same. A sparse zone with "relatively few" data separates clusters, which can be thought of as dense areas in the data space. Assuming this, a cluster may have an "arbitrary" or "regular" shape (Rupanka Bhuyan, 2013).

Spatial clustering is a grouping technique of points based on geographic proximity, which is also the objective of this study. The literature suggests DBSCAN (Density-Based Spatial Clustering of Applications with Noise) as an adapted method for this purpose (Martin Ester, 1996) and the following indicators are provided to support this suggestion. Clusters can have different irregular shapes, and points that are not included in them, which make up what is called noise, are treated separately. These are elements that correspond to the specific situations of this study.

Therefore, DBSCAN clustering technique is used in this paper, and uses the density-based concept of clusters to find clusters of any shape.

3.1. Data

Since access to cadastral and census data was limited, the primary data source for this application is OpenStreetMap, retrieved and processed using GIS tools.

Due to the increasing affordability of their hardware and the ease of use of their software, GIS tools have grown in popularity. By offering a single source of up-to-date and historical data and maps, GIS can make a map more current and relevant. This lowers the cost of data storage and improves the effectiveness of thematic mapping. With a single data storage and management system, GIS facilitates better collaboration and makes it simple to store, arrange, and retrieve data from several sources (Xuejing Xie, 2019).

With easier access to more current and important geographic data, strategic decision-making will receive better support and help. Consequently, planners are able to plan more efficiently and make well-informed decisions. They can also investigate a greater variety of what-if scenarios, which leads to more dependable, strong, and effective long-term plans.

Datasets available at various levels of spatial aggregation are typically used in GIS projects and these include also census data by area or block and data related to a specific site or parcel.

The attribute data, or indexed data that are generated by GIS tools, are composed of ***j*** attributes (features) in columns that specify ***n*** items (records and samples) in rows. Each row represents an item, while the columns carry the entity' features (characteristics).

Using simple statistical tools or learning algorithms, this attribute data models are easier to be analyzed due to their higher accuracy (Stéphane C. K. Tékouabou, 2022). However, they have the disadvantage of being expensive or challenging to get over a large geographic area.

The dataset of buildings used in this study is exported from OpenStreetMap (OSM) and using a QGIS, an open-source Geographic Information Systems (GIS) tool converting them into csv file for further analysis. Since OSM in an open-source mapping platform where anyone can edit and contribute with information about roads, buildings and businesses, sometimes is not accurate enough. To ensure the accuracy of our data we have done a comparison with the data shared by ASIG (State Authority for Geospatial Information), that is government institution responsible for monitoring spatial planning, maintaining of topographic and cadastral maps and geospatial data management in Albania and also with data from PPV (General Local Plan) that is strategic urban planning document. Based on these comparisions, which took into account the number of buildings, number of floors and separation of land use, to obtain more accurate results some data have been added or digitized using the latest orthophoto.

The dataset contains accurate information on:

- The building's exact location (latitude and longitude)
- The total built surface (above ground)
- The year of construction
- The building's function (residential / non-residential)
- The building's altitude (number of floors above ground)
- The building's footprint (squared meters)

The groundwork for calculating urban density is provided by these factors. To guarantee accuracy, buildings lacking key features were eliminated and the data was cleansed to eliminate inconsistencies.

3.2. Implementation

We use building-level data in this study to define urban regions in Tirana using a density-based clustering technique. Our method, which incorporates both horizontal and vertical indicators of urban growth, identifies urban regions based on the spatial distribution and density of buildings, in contrast to previous methods that rely on administrative boundaries. This enables to find urban areas that are functionally coherent and represents more accurately the actual urban fabric. Methodology is going to be separated in some steps, as following:

a. Data preparation

The dataset contains accurate information on the number of floors, footprint area, building location (latitude and longitude) and the function of building (residental/non-residental).

b. Measuring urban density

To quantify urban density, we consider two complementary dimensions (key indicators):

- Horizontal density (footprint area)

Horizontal density is a measure of built-up land coverage that represents the entire area occupied by building footprints with a specific cluster. This adds in determining the amount of land that has been developed, but it does not take into consideration differences in building height.

- Vertical density (number of floors)

Because cities expand upward as well as outward, we take building heights into account to obtain a more accurate indicator of urban intensity. Vertical density is a measure of the total built-up volume in an area that is computed by multiplying the footprint of each structure by the number of floors.

The reason why we measure the vertical density as number of floors and not the shape length is because number of floors are directly linked to occupant potential.

We distinguish between low-density expansion and high-density city centers by combining both horizontal and vertical density, which gives our approach a more nuanced depiction of metropolitan areas.

c. Clustering urban zones

To define urban areas based on density we employ DBSCAN, a widely used machine learning algorithm that groups data points (in this case, buildings) based on their spatial proximity.

- Key parameters of DBSCAN:
    - Epsilon(Ɛ): the maximum distance between two buildings for them to be considered part of the same cluster. Cities with comparable global densities may have various thresholds, which are specific to each area under study and determined a posteriori. We tested different values to optimize results.
    - MinPts (Minimum buildings per Cluster): the minimum number of buildings required for a group to be classified as an urban area.
    - Density Criteria: The clustering is based on both footprint coverage and vertical expansion, ensuring that areas with high-rise buildings are accurately represented.
- Benefits of DBSCAN:
    - It can identify clusters of any shape.
    - There is no need to know previously how many clusters there are.
    - There is a concept of noise (items that don't belong to any cluster).

- MinPts and ε are the only two 2 input parameters, and they are mostly unaffected by the database's point ordering.

- Drawbacks of DBSCAN
  - It is challenging to accurately determine the values of the parameters ε and MinPts.
  - The computational complexity for n data objects is O(n2) in the absence of any specific structure or spatial indexing.

DBSCAN works by selecting a building at random and drawing a search radius (Ɛ). This threshold in some studies is defined by commuting patterns (Ying Long, 2015), because population mobility plays a crucial role in the life of individual and also in economic system's performance. But since Albania is a developing country, no accurate data is available for this commuting patterns. Therefore, it has been used the threshold of 5.88km. This because it is the mean average of commuting distance in Tirana based on different types of commuting. After trying it, this distance does not give good results of clustering.

Some different values were tried to optimize results and checked for each value if in radius are enough buildings (MinPts), expanding clusters where the density is sufficient and excluding outlier buildings that do not belong to any urban area.

This algorithm has some disadvantages, like becoming quite inefficient for big datasets, because its computational complexity without any spatial structure or indexing is $O(n^2)$ for n data objects, that is relatively high compared to other clustering methods.

Considering this and based on previous works (Daniel Arribas-Bel, 2021; Dina Nur Amalina, 2024), some extensions of DBSCAN like ADBSCAN and HDBSCAN have been tried to apply to increase stability and lower mistakes from outliers.

Since these approaches do not make assumptions about predetermined shapes or bounds, it is very helpful for urban study. Instead, it naturally adjusts to the organic spread of structures, capturing both outer urban extensions and dense metropolitan cores.

After defining the clusters, the alpha shape algorithm is used to draw boundaries around this clusters. Rather than just generating a basic outside boundary, the Alpha Shape algorithm is an innovative way of outlining a collection of points by shaping them to represent their actual form. Imagine it as a flexible version of the convex hull that adjusts according to a parameter called α rather than wrapping points in a tight rubber band. While a greater α smoothes things out and makes the shape more rounded, a smaller α clings the points closely, capturing intricate curves and concavities. Because cities don't often follow exact geometric patterns, this makes it incredibly helpful when mapping metropolitan regions. For instance, Alpha Shapes assist in creating realistic city boundaries that honor the natural flow of structures after buildings have been clustered using an algorithm such as DBSCAN. It's particularly useful when working with irregular shapes, ensuring that intricate city layouts are not forced into simplistic outlines.

d. Locating employment centers

The approach mentioned above can also be used to identify employment centers inside cities in addition to defining urban areas. Using the same clustering approach, we can only look at non-residential structures (commercial, office, and industrial areas) because economic activity is frequently concentrated in particular districts.

Because of the variety of businesses and the wide range of workforce sizes, it is difficult to pinpoint the precise average number of employees per non-residential unit in Tirana, Albania. Nonetheless, the information at hand offers some insights: In Albania, small businesses – defined as those with one to four employees – make up about 85.9% of the market. Even though they are common, they account for 20.2% of yearly turnover and 22.6% of employment. On the other hand, although they only make up 1.6% of all businesses, larger companies with 50 or more employees employ half of the nation's workforce and account for 45.3% of annual revenue.

Since the data available at the moment are not so precise, in further works we also tend to define a density threshold of non-residential unit per km² that can be used to define employment clusters and try to define a detailed map of economic hubs within Tirana, highlighting areas of intense business activity.

4. Results

Based on the methodology explain above, some results generated by the algorithms are shown. These results are the combination of different parameters that these algorithms take into consideration for the clustering.

- Application of DBSCAN in our dataset

After trying different combinations of parameters (MinPts and ε), based on the images generated and the clusters that were created, below are the clearest delineation of the urban zones.

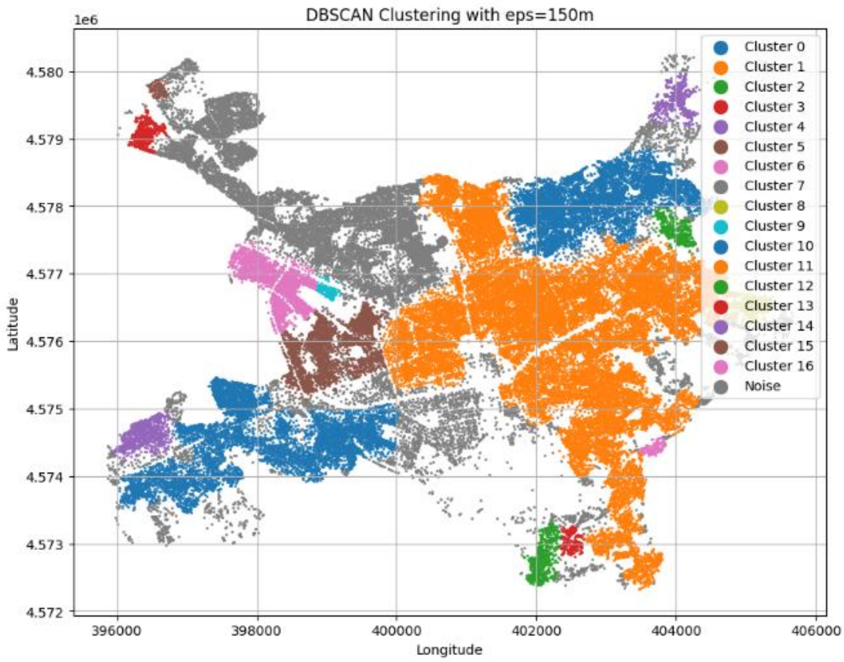

Figure 1. *DBSCAN Clustering with parameters epsilon = 150, minimum samples = 90.*

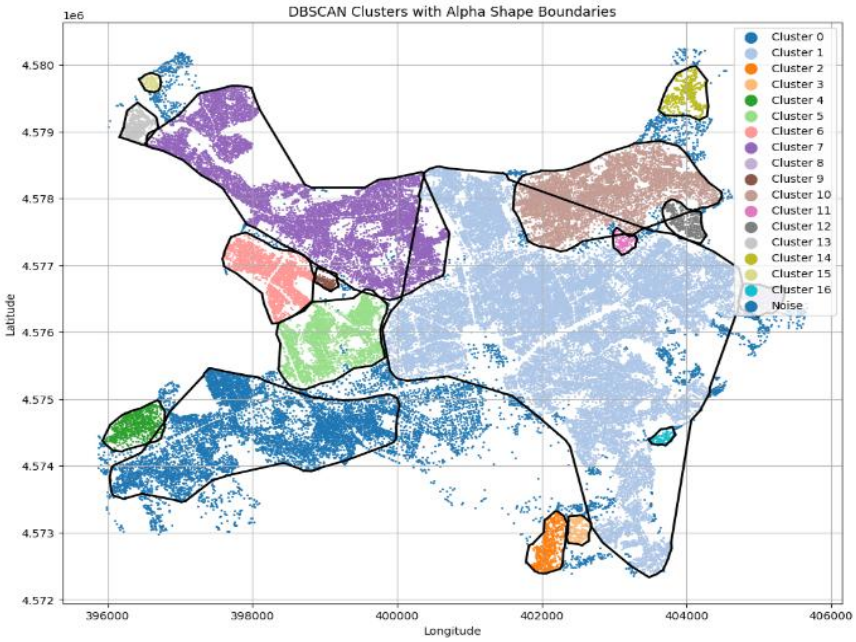

Figure 2. *Alpha shape boundaries.*

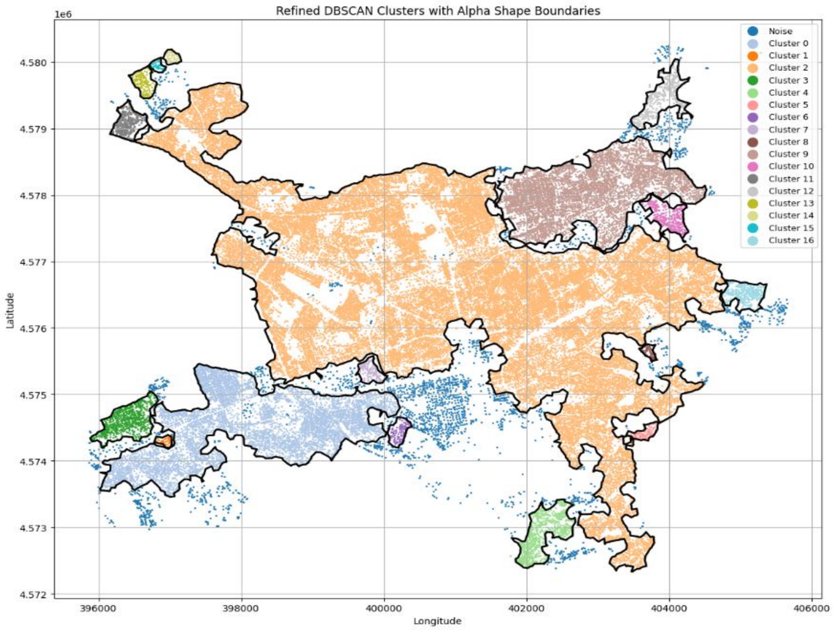

Figure 3. *Refined DBSCAN, eps 130, minimum samples 60, noise removed*.

- Application of A-DBSCAN algorithm

We have used these parameters: eps = 150, min_samples = 90 to avoid small, noisy clusters. To keep stability n_iterations = 200 and sample_fraction = 0.7. It is recommended to use 70% of data per iteration for better cluster consistency.

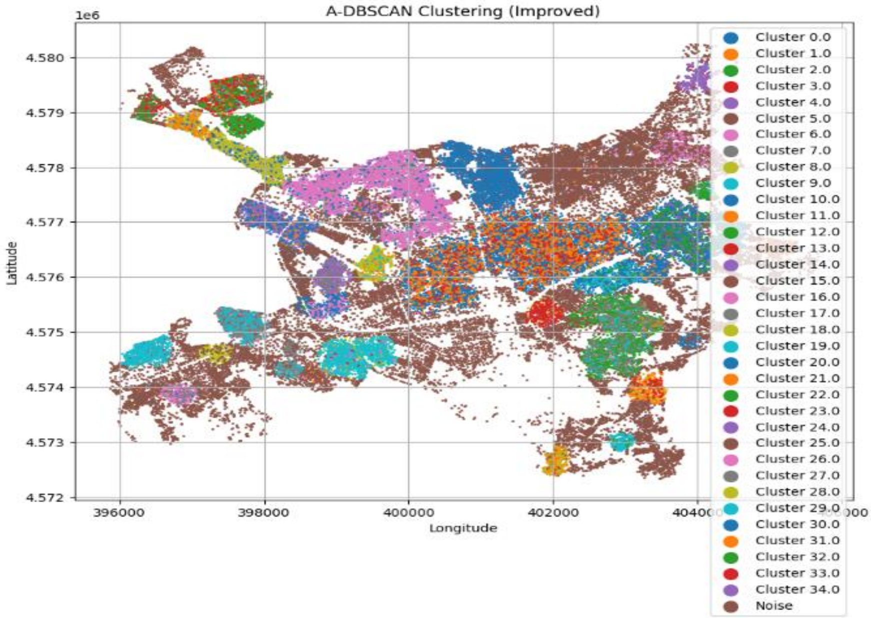

Figure 4. *First A-DBSCAN application.*

Here is an improved A-DBSCAN where parameters are updates:

- eps = 150 -> Keep the best found DBSCAN distance
- min_samples = 70 -> Lower min_samples to reduce noise
- n_iterations = 300 -> Increase iterations for better stability
- sample_fraction = 0.7 -> Use 70% of data per iteration

Despite our attempts to improve the generation through different combinations of parameters, the result continues to remain unclear and alpha shape algorithm cannot be applied.

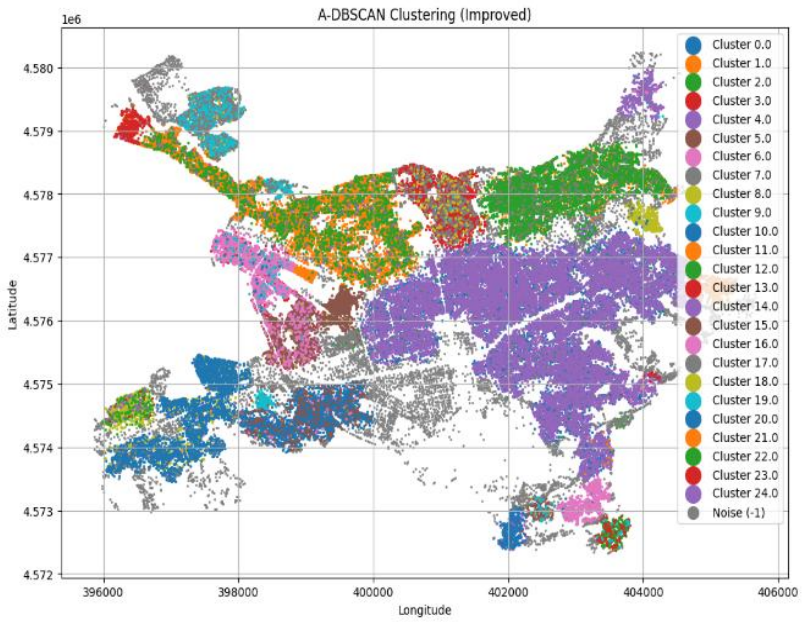

Figure 5. *ADBSCAN Improved version.*

- Application of HDBSCAN

Since our dataset represents areas with varying spatial densities (e.g., urban core versus suburb), we also applied HDBSCAN, which builds a density hierarchy through mutual reachability distance and selects the most stable classes from the condensed tree. This approach reduces the sensitivity to the global parameterization of ε of DBSCAN and improves the identification of classes with non-convex shapes and different densities, providing a stronger filter for noise/outliers and useful metrics such as membership strength. In practice, HDBSCAN requires fewer parameter adjustments (mainly min_cluster_size) and produces more robust and reproducible results on large spatio-urban datasets.

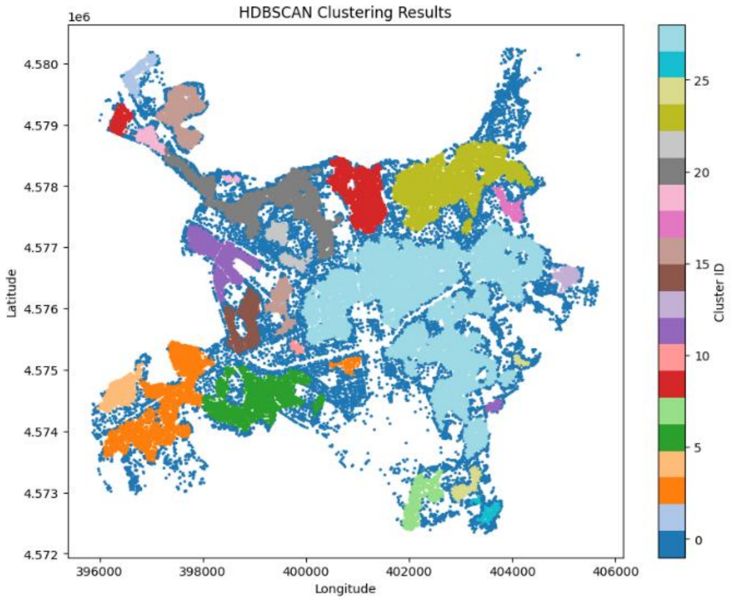

Figure 6. *HDBSCAN clustering results for the best paramter combination.*

An actual overview of the urban areas of Tirana has been provided below, showing a map created by ASIG and approved by the National Council of Territoriality (KKT), which provides an overview, based on VKM no. 5, dated 29.12.2014 "On the identification of urbanized areas throughout the territory of the Republic of Albania and the approval of maps where interventions can be made in the function of urban development". However, the question arises: What is exactly this overview showing?

What can be distinguished with the naked eye from the map is a large polygon in the center, with an aerial radius of 3.3 km, which classified all of Tirana as a massive urban area, accompanied by several other secondary polygons such as: Mëzezi, Yzberisht, Farkë, Paskuqan, Shish Tufinë etc. But why was this classification done in this way and where do these urban areas (clusters) come from? According to the current VKM, these areas have been identified as buildable areas, based on the actual condition of existing buildings, where new construction can be added within the framework of urban development. In principle, it makes sense, since for an urban area, the main indicators would be the number of buildings and their density. But why exactly this type of division, these polygons? The VKM cannot answer this, and the map does not provide any concrete evidence, unless we consider them divisions with an administrative function.

Figure 7. *Map created by ASIG.*

Considering the current administrative division and comparing the results of various algorithms used for the urban division of Tirana, it is evidenced that the DBSCAN algorithm provides the most consistent division based on three major factors: the first and most important is the presence of buildings, followed by the horizontal and vertical density, which are the indicators that define an urban area (figure 2).

But does this method take into consideration the morphological aspects? How can we encode the urban morphology in a digitalized representation that can be both fed into an algorithm and understood by urban planners?

Although the suggested delineation method provides a reliable, data-driven solution for locating urban areas according to building-level density and distance, it does not specifically take into account the built environment's morphological features. The spatial form or structure of urban agglomerations is irrelevant to this density-based logic, which does not assess spatial coherence, fragmentation, shape, or proximity. Therefore, even if they lack morphological coherence, linear formations along transportation corridors or dispersed peri-urban developments may be included in the same urban cluster.

To address this limitation, we tend to introduce a complementary morphological analysis. In particular, we will employ tools like MorphoLim to add morphological criteria, like boundary smoothing, continuity, and compactness. By capturing not just functional closeness but also the physical and spatial coherence of urban form, this allows us to fine-tune the delineation of urban extents in Tirana. We hope to develop a border that is both statistically sound and morphologically significant by integrating the two approaches, particularly in a city like Tirana where complex spatial patterns are created by irregular urban expansion and informal settlements.

5. Conclusion

The findings demonstrate that density-based clustering captures a more realistic functional footprint of Tirana than administrative polygons. Beyond its analytical value, this approach has direct implications for urban governance: it supports the identification of service gaps, informs land-use zoning, and assists in prioritizing infrastructure investment within high-density clusters. Moreover, the delineated employment centers can guide transport-planning and resilience strategies by linking spatial form with economic performance.

In a broader perspective, adopting data-driven delineations encourages transparency and evidence-based policymaking, aligning with Albania's objectives for Europe integration.

Over the past few years, a number of techniques have been developed to define urban regions using growing amounts of data. To better understand and manage the urban dynamics, in this research we presented a method for calculating Tirana's urban zones and borders that relies on individual buildings, which are the most fundamental elements of cities.

Our delineation based on a data-driven algorithm, DBSCAN, is better than those produced by traditional methods that rely on administrative borders. We think that these defined urban areas more accurately represent the concept of an urban agglomeration based on a high concentration of people and businesses since they are spatially continuous groupings of buildings rather than exogenous aggregations like grid cells or administrative boundaries.

Even though this approach significantly improves the accuracy of urban area delineation, these findings have applications that go well beyond scholarly curiosity. This method can be an effective tool for urban planners and policy-makers in a number of important sectors, leaving room for further analysis of different urban factors.

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