BOOK OF PROCEEDINGS

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

TOWARDS EURO-MEDITERRANEAN PERSPECTIVES

OCTOBER 16th-17th, 2025

ISBN: 9789928347237

DOI: 10.37199/c41000900

CIP Katalogimi në botim BK Tiranë
2nd international conference on housing, planning, and
resilient development of the territory : towards
euro-mediterranean perspectives : october 16th-17th, 2025 :
book of proceedings. - Tiranë : Universiteti Polis, 2026.
... f.
ISBN 9789928347237
1.Urbanistika 2.Planifikimi i qytetit dhe ligji i
rizhvillimit 3.Konferenca
711 (062)

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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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Air, water, and soil pollution / Ecosystem services for protected and urban areas / Strategic environmental assessments / Nature-based solutions / Urban biodiversity assessment.

Assessing the Impact of Urban Form on Air Quality

The Case Study of the Ish-Fusha e Aviacionit Neighborhood

DOI: 10.37199/c41000930

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Abstract

Air pollution is a leading environmental and public health concern, contributing to approximately 8.1 million premature deaths annually worldwide. Rapid and unplanned urbanization, particularly in densely populated areas, is a major factor influencing air quality. This study investigates the impact of urban morphology on air quality in the Ish-Fusha e Aviacionit neighbourhood in Tirana, Albania. The area, which has undergone significant development in recent years, presents a valuable case for analysing how urban form affects pollutant concentration and air circulation.

By combining air quality monitoring with spatial analysis using GIS tools, the study assesses key factors such as building density, road networks, population distribution, green spaces, and the availability of air corridors. Field measurements were conducted using the Aeroqual S500 device to monitor pollutants ($PM_{2.5}$, PM_{10}, NO_2, and CO_2), while urban temperature and CO_2 was recorded with a Testo-435. Vegetation coverage was analyzed using NDVI data from Sentinel-2 satellite imagery. The collected data were further processed through spatial interpolation in ArcGIS and statistically analyzed using SPSS to explore correlations between pollutant concentrations and temperature.

The results reveal that compact, high-density urban forms with limited vegetation and obstructed air corridors are associated with higher levels of air pollution. Subzones with closely spaced high-rise buildings exhibited the highest concentrations of $PM_{2.5}$ and NO_2, while CO_2 levels were elevated in areas dominated by vehicular traffic and poor ventilation. Furthermore, Pearson correlation analysis indicated a positive relationship between CO_2 concentrations and temperature, suggesting that areas with higher emissions also tend to retain more heat, likely due to restricted airflow and limited green cover. Conversely, subzones with lower building density, greater vegetative cover, and better spatial openness displayed significantly lower pollutant concentrations. Temperature measurements confirmed urban heat island effects, with denser and less vegetated areas retaining more heat. NDVI analysis demonstrated a strong inverse correlation between vegetation density and air pollution levels.

These findings demonstrate the strong interconnection between urban morphology, air quality and temperature, reinforcing the need for urban planning approaches that integrate nature-based solutions and prioritize spatial ventilation to promote healthier, more resilient urban environments.

Keywords

Urban morphology, air quality, urbanization

1. Introduction

Rapid and often unsustainable urbanization is among the most pressing challenges faced by modern cities, with direct environmental, social, and health implications. Air pollution, largely driven by motorized transport, residential heating, industrial processes, and the reduction of green spaces, poses a significant public health risk, with approximately 90% of the global population living in areas exceeding WHO air quality guidelines.

In Albania, accelerated urban growth over the past three decades – particularly in Tirana – has intensified infrastructure demand, reduced per capita green space, and increased private vehicle use, all contributing to deteriorating air quality. The Ish-Fusha e Aviacionit area exemplifies this transformation, shifting from low-density, green-yard housing to high-rise developments, reduced open space, and altered microclimatic conditions. Understanding how these changes affect air quality is essential for sustainable urban planning.

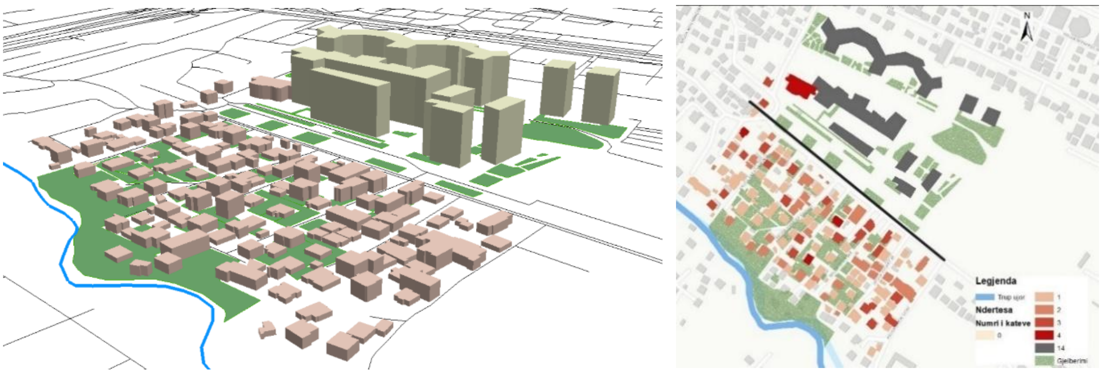


Figure 1. *Area under study.*
Source: Author.

1.1. Research question/hypothesis

This study investigates whether, and to what extent, changes in urban form and land use – particularly building density, loss of green space, and street network configuration – have influenced air quality in the Ish-Fusha e Aviacionit area of Tirana. The hypothesis is that higher building density, reduced vegetation cover, and altered spatial configuration hinder air circulation and contribute to the accumulation of air pollutants.

1.2. Objectives and scope of the study

The main objective is to assess the relationship between urban form, land-use patterns, and air quality in a rapidly developing neighbourhood. Specifically, the study aims to:

1. Analyse the spatial distribution of buildings and its impact on pollutant concentrations.
2. Evaluate the role of green spaces and air corridors in improving air quality and regulating urban temperature.
3. Propose evidence-based recommendations for urban planning policies that integrate nature-based solutions to mitigate air pollution.
4. The scope is limited to the Ish-Fusha e Aviacionit area, serving as a representative case study for other rapidly urbanizing neighborhoods in Albania and similar contexts in the region.

2. Literature review

Urbanization and the resulting changes in urban morphology have significant implications for air quality and microclimate regulation in cities. Previous studies have demonstrated that the configuration of buildings, street canyons, and urban density can strongly influence pollutant dispersion and accumulation. Liang and Gong (2020) highlighted that urban landscape patterns, including building height, density, and arrangement, affect air movement and pollutant distribution, emphasizing the importance of considering urban form in air quality management. Similarly, Xie, Zhang, and Wang (2019) reviewed the effects of urban morphology on air pollution dispersion, noting that densely built environments with poorly ventilated streets often experience higher pollutant concentrations.

Green infrastructure has been widely recognized as a mitigating factor for urban air pollution. Mori, Ferrini, and Saebo (2018) discussed how urban greening, including parks, street trees, and green roofs, can act as natural filters, reducing particulate matter and improving local air quality. Case studies from Medellín illustrate that green corridors and vegetated areas can significantly reduce urban heat and improve natural ventilation, thereby contributing to lower pollutant concentrations (PreventionWeb, 2021). Cárdenas Rodríguez, Dupont-Courtade, and Oueslati (2016) further demonstrated in European cities that linking green infrastructure with strategic urban planning can enhance pollutant dispersion and mitigate air pollution hotspots.

Meteorological parameters and seasonal variations also play an important role in urban air quality. Guo et al. (2022) highlighted that temperature, wind speed, and atmospheric stability significantly affect the occurrence of air pollution episodes, particularly in basins or densely built regions. This is complemented by studies showing that urban heat islands, exacerbated by low vegetation cover and high building density, can alter local microclimates and trap pollutants, leading to degraded air quality (Li et al., 2018; Liang et al., 2020).

Despite extensive research, several gaps remain. Most studies have focused on large metropolitan areas in Europe or Asia, leaving smaller urban neighborhoods in rapidly developing cities underexplored. Moreover, while the role of green spaces and ventilation corridors is acknowledged, few studies have integrated empirical air quality measurements, spatial analysis via GIS, and satellite-derived indices such as NDVI to assess microclimatic effects comprehensively. In the context of Albanian cities, including Tirana, there is a lack of localized, fine-scale studies linking urban form with pollutant dispersion, especially in newly urbanized areas like Ish-Fusha e Aviacionit (Shehu & Dhrami, 2025; Wang, Zhou & Sun, 2022).

This study addresses these gaps by adopting an integrated methodological approach that combines field monitoring of key air pollutants (PM2.5, PM10, NO2, CO2), urban morphology analysis using GIS shapefiles, and assessment of green spaces and air corridors through satellite imagery and NDVI indices. By linking urban configuration, vegetation, and natural ventilation patterns, the research aims to provide actionable insights for urban planning interventions that enhance air quality and improve the urban microclimate in high-density neighborhoods. Consequently, the study not only builds on existing theoretical frameworks but also contributes empirical evidence for sustainable urban management in rapidly urbanizing contexts.

3. Methodology

3.1. Research design and approach

This study adopts an integrated research approach combining theoretical concepts, case study analyses, field measurements, and air quality assessments to evaluate the relationships between urban form, greenery, and natural air corridors. The theoretical framework focuses on the impact of urban structure and design on air circulation and pollutant dispersion, including literature on building configuration, density, and orientation. Studies highlight the role of green spaces as natural filters for pollutants and as contributors to the reduction of urban heat island effects.

To contextualize these theoretical insights, comparative case studies were selected from cities facing similar challenges to the Ish-Fusha e Aviacionit area in Tirana. Medellín, Frankfurt, and Saint Petersburg provide complementary examples: Medellín emphasizes the creation of green networks in high-density areas, Frankfurt focuses on natural air corridor planning for optimal ventilation, and Saint Petersburg demonstrates the effects of urban form and building orientation on pollutant accumulation. The integrated analysis of these cases informs recommendations for urban planning aimed at improving air quality and microclimatic conditions.

3.2. Data collection and analysis methods

The empirical focus is the Ish-Fusha e Aviacionit neighborhood in Tirana, characterized by rapid urbanization and high building density. The study area comprises two subzones: a highly developed sector with dense high-rise buildings and a developing sector, allowing direct comparison of urbanization impacts on environmental conditions.

Air Quality: Air pollutants including $PM_{2.5}$, PM_{10}, NO_2, and CO_2 were monitored using the Aeroqual S500 device at multiple points within each subzone. Data were processed and visualized through ArcMap to produce pollutant distribution maps.

Urban Temperature: Urban temperatures were measured on-site using a Testo probe, complemented by satellite-derived NDVI indices to assess the impact of vegetation absence on local heat accumulation.

Urban Form and Building Configuration: Spatial analyses were conducted in ArcMap using vector (shapefiles) and raster datasets to evaluate building height, density, and orientation.

Green Spaces and Air Corridors: Satellite imagery and GIS analyses were used to identify green areas and natural air corridors and assess their contribution to urban ventilation.

Spatial Data Processing: Data on buildings, road networks, and water bodies were sourced from official TR030 plan shapefiles and the Albanian Cadastre Agency (AKPT). Processing included clip, merge, and buffer operations to limit analysis to the study area and evaluate road network impacts on pollutant dispersion. Heat maps were created using the Inverse Distance Weighting (IDW) method.

Statistical Analysis: Collected data were analyzed using SPSS to identify statistically significant relationships between spatial configuration, climatic parameters, and air pollution levels.

Indicator	Measurement Method	EU Standard	Notes
$PM_{2.5}$	Instrumental monitoring	10 µg/m³	Multiple points
PM_{10}	Instrumental monitoring	20 µg/m³	Multiple points
NO_2	Instrumental monitoring	40 µg/m³	Multiple points
CO_2	Instrumental monitoring	350 ppm	Multiple points
Temperature	On-site measurement & satellite	8°C (Feb), 19°C (May)	NDVI used for vegetation effect
Greenery	GIS mapping	–	Area in m²
Air corridors	GIS mapping	–	–

Table 1. *Environmental indicators and measurement methods.*

3.3. Ethical considerations

The study adheres to standard ethical practices for environmental research. All field measurements were non-invasive and conducted in public spaces, ensuring no risk to participants. Data collection and spatial analyses used publicly available datasets or author-generated data, maintaining confidentiality and compliance with local regulations. The methodology can be safely replicated in other urban contexts without ethical concerns.

4. Results

The field measurements and spatial analyses provided insights into the air quality and urban microclimate of Ish-Fusha e Aviacionit, focusing on two distinct subzones:

- Zone A, representing the newly developed area with multi-story buildings and modern infrastructure, and
- Zone B, which remains relatively undeveloped and retains traditional structures.

This comparative approach allowed the assessment of how urbanization influences pollutant concentrations and microclimatic conditions.

4.1. Air quality measurements

- PM2.5 and PM10: In Zone A, average concentrations reached 28 µg/m³ (PM2.5) and 35 µg/m³ (PM10), compared to 18 µg/m³ and 24 µg/m³ in Zone B.
  - First monitoring round values varied between 9–18 µg/m³ (PM2.5) and 1–22 µg/m³ (PM10). Several stations exceeded EU annual guidelines (10 µg/m³ for PM2.5; 20 µg/m³ for PM10).
  - In the second round, PM2.5 ranged from 9–23 µg/m³ and PM10 from 19–31 µg/m³, showing higher levels particularly in Zone A.

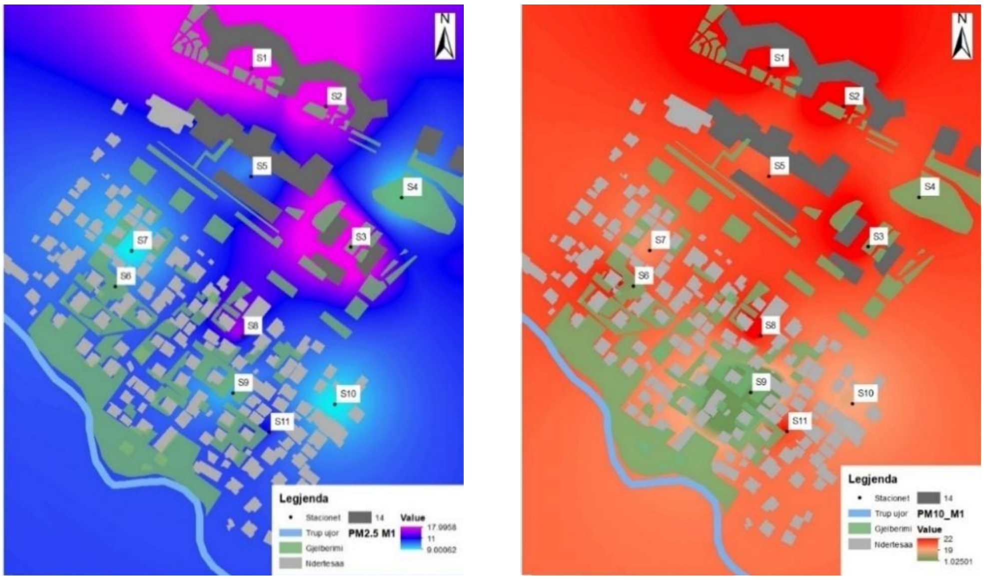


Figure 2. *Concentrations of $PM_{2.5}$ (left) and PM_{10} (right) during the first monitoring round.*
Source: Author.

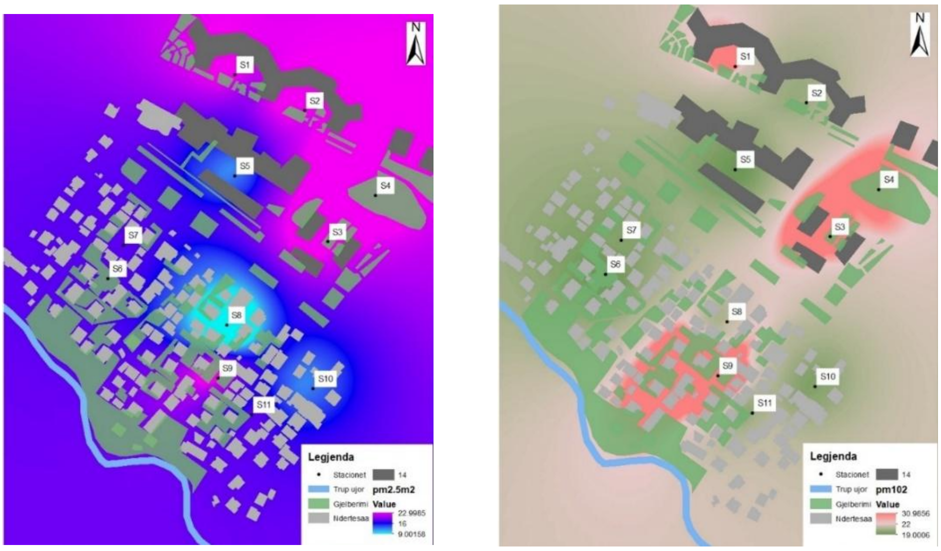


Figure 3. *Concentrations of $PM_{2.5}$ (left) and PM_{10} (right) during the second monitoring round.*
Source: Author.

- NO_2: Concentrations peaked at 62 µg/m³ (Round 1, Station 5) and 54 µg/m³ (Round 2, Station 3), surpassing the EU annual limit of 40 µg/m³. Elevated levels were consistently linked to traffic corridors and combustion processes in Zone A.

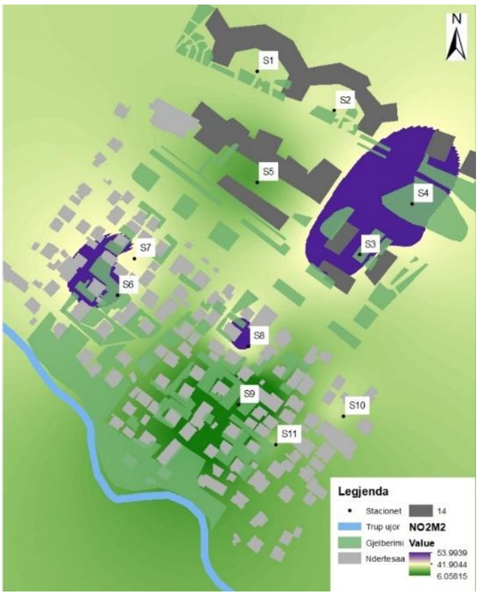


Figure 4. *Concentrations of NO_2 during the first monitoring round.*
Source: Author.

- CO_2: Ranged between 298-435 ppm in Round 1 and 330-420 ppm in Round 2. Higher values were found in densely built areas, suggesting poor natural ventilation and strong anthropogenic influence.

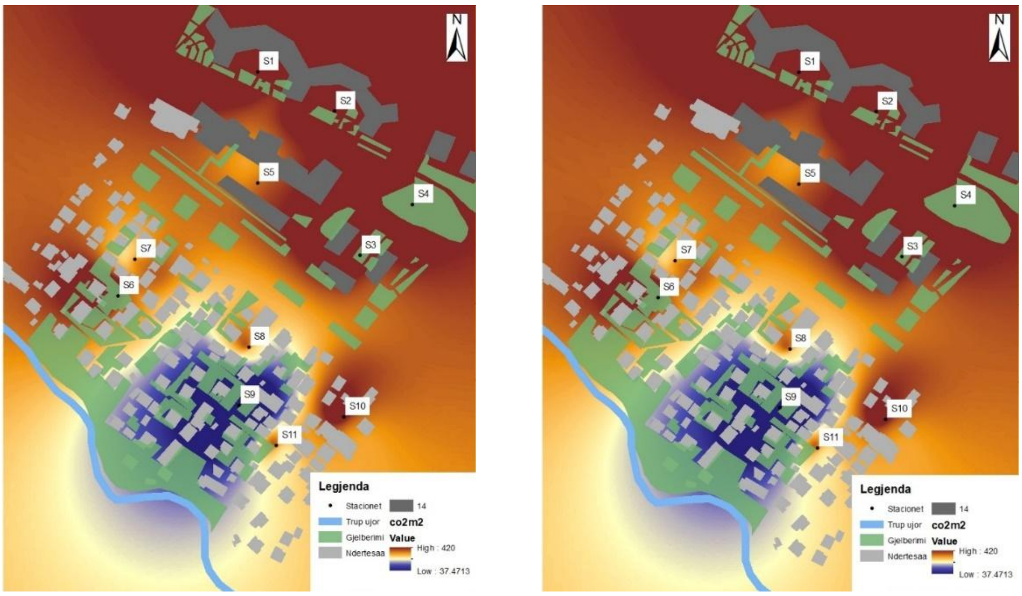


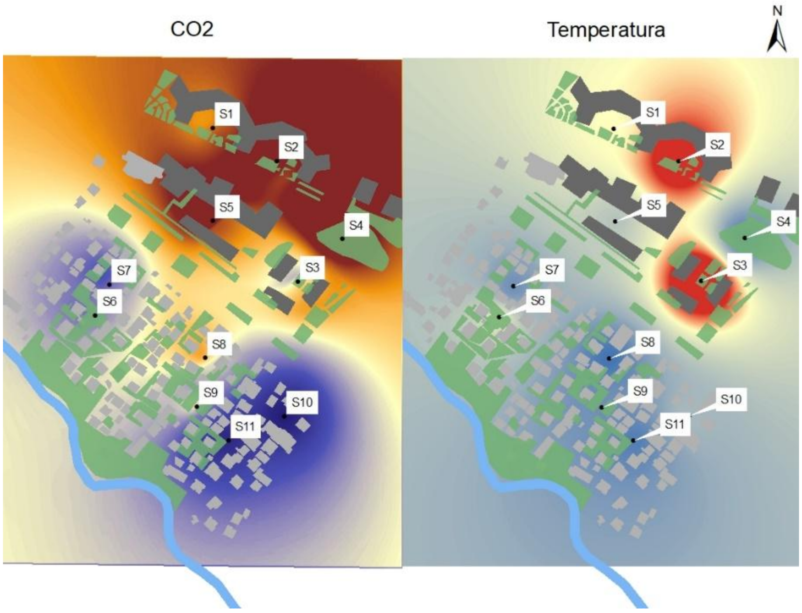
Figure 5. *Concentrations of CO_2 during the first monitoring round (left) and during the second monitoring round (right).*

Source: Author.

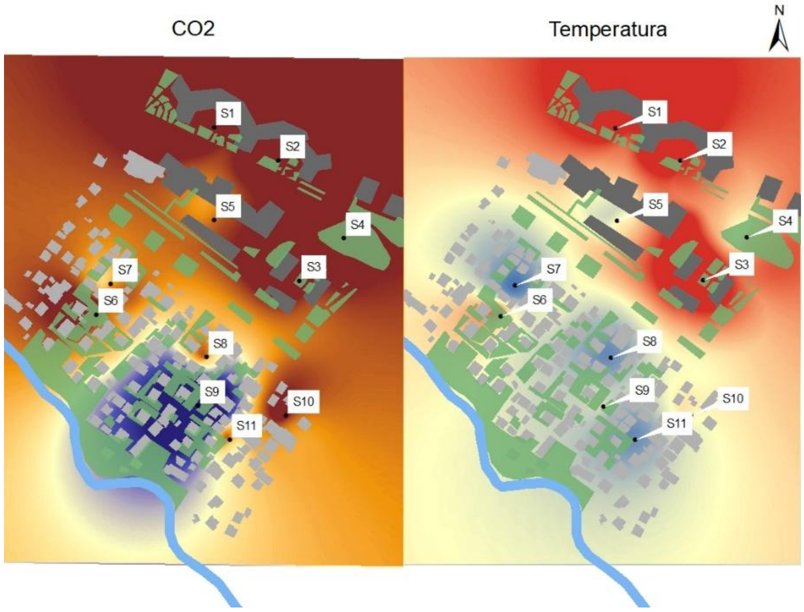
- Temperature: A clear difference of 3–4°C was observed between compact built-up areas and greener zones, consistent across both monitoring rounds.

Correlation analysis

- Round 1: Strong positive correlations were found between temperature and CO_2 ($r = 0.792$, $p < 0.01$) and temperature and PM2.5 ($r = 0.777$, $p < 0.01$). CO_2 also correlated strongly with PM2.5 ($r = 0.762$, $p < 0.01$).



- Round 2: Correlation between temperature and CO_2 increased further ($r = 0.918$, $p < 0.01$), indicating higher sensitivity of CO_2 accumulation under warmer conditions. A significant correlation remained between PM2.5 and CO_2 ($r = 0.621$, $p < 0.05$).
- PM2.5 and PM10 also showed significant co-variation (Round 1: $r = 0.625$, $p < 0.05$), confirming shared emission sources such as traffic and construction activities.



Correlation analysis

The correlation analysis provided further insights into the interactions among pollutants, temperature, and CO_2 levels in both monitoring rounds.

During the first round, strong positive correlations were observed between temperature and CO_2 ($r = 0.792$, $p < 0.01$), as well as between temperature and $PM_{2.5}$ ($r = 0.777$, $p < 0.01$). $PM_{2.5}$ and PM_{10} also exhibited a significant positive correlation ($r = 0.625$, $p < 0.05$), suggesting common sources or similar dispersion behavior. Interestingly, NO_2 did not show significant correlations with the other parameters, implying that traffic-related NO_2 emissions may follow different temporal or spatial patterns compared to particulate matter and CO_2.

Correlations

		Temperature	CO_2	NO_2	$PM_{2.5}$	PM_{10}
Temperature	Pearson Correlation	1	.792**	.321	.777**	.420
	Sig. (2-tailed)		.004	.336	.005	.199
	N	11	11	11	11	11
CO_2	Pearson Correlation	.792**	1	.506	.762**	.366
	Sig. (2-tailed)	.004		.112	.006	.268
	N	11	11	11	11	11
NO_2	Pearson Correlation	.321	.506	1	.284	.080

	Sig. (2-tailed)	.336	.112		.397	.815
	N	11	11	11	11	11
$PM_{2.5}$	Pearson Correlation	.777**	.762**	.284	1	.625*
	Sig. (2-tailed)	.005	.006	.397		.040
	N	11	11	11	11	11
PM_{10}	Pearson Correlation	.420	.366	.080	.625*	1
	Sig. (2-tailed)	.199	.268	.815	.040	
	N	11	11	11	11	11

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
Table 2. *Statistical analysis for first-round data.*

In the second monitoring round, a very strong positive correlation was detected between CO_2 and temperature ($r = 0.918$, $p < 0.01$). CO_2 also showed a moderate positive correlation with $PM_{2.5}$ ($r = 0.621$, $p < 0.05$). By contrast, NO_2 was negatively correlated with PM_{10} ($r = -0.582$, $p = 0.061$), though this was only marginally significant, suggesting a potential divergence in emission dynamics or dispersion conditions. The strong association of CO_2 with both $PM_{2.5}$ and temperature highlights the role of dense urban morphology in trapping heat and pollutants.

Correlations

		$PM_{2.5}$	PM_{10}	CO_2	NO_2	Temperature
$PM_{2.5}$	Pearson Correlation	1	.550	.621*	-.138	.550
	Sig. (2-tailed)		.080	.041	.685	.079
	N	11	11	11	11	11
PM_{10}	Pearson Correlation	.550	1	.254	-.582	.213
	Sig. (2-tailed)	.080		.451	.061	.530
	N	11	11	11	11	11
CO_2	Pearson Correlation	.621*	.254	1	.238	.918**
	Sig. (2-tailed)	.041	.451		.482	.000
	N	11	11	11	11	11

NO_2	Pearson Correlation	-.138	-.582	.238	1	.290
	Sig. (2-tailed)	.685	.061	.482		.387
	N	11	11	11	11	11
Temperature	Pearson Correlation	.550	.213	.918**	.290	1
	Sig. (2-tailed)	.079	.530	.000	.387	
	N	11	11	11	11	11

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 3. *Statistical analysis for second-round data.*

The correlation results confirm that particulate matter and CO_2 tend to co-vary under conditions of limited atmospheric ventilation, as observed in the denser urban subzone. The first-round analysis demonstrated that rising temperatures were linked with increases in both CO_2 and $PM_{2.5}$, which aligns with the heat-island effect intensifying pollutant accumulation. In the second round, the correlation between CO_2 and temperature became even stronger, suggesting that seasonal or meteorological changes may amplify the entrapment of pollutants in compact urban environments.

The weak or negative correlations involving NO_2 indicate that traffic-related emissions may disperse more quickly than particulate matter under certain conditions, or that NO_2 peaks occur during specific traffic hours not fully captured by the monitoring sessions. This contrasts with $PM_{2.5}$ and CO_2, which reflect more cumulative and spatially consistent pollution loads.

Comparing the two monitoring rounds reveals that while PM and CO_2 relationships remained relatively consistent, NO_2 behaved differently, underscoring the need for higher temporal resolution monitoring to capture traffic-related peaks. These findings align with previous studies (e.g., Liang & Gong, 2020; Guo et al., 2022) that emphasize how urban form and meteorological conditions jointly determine pollutant dispersion and accumulation.

4.2. Urban form and vegetation

- NDVI analysis indicated vegetation cover of only 12% in Zone A compared to 27% in Zone B.
- GIS-based urban form analysis showed high building density and low street orientation variability in Zone A, leading to "urban canyon" effects that restrict natural ventilation.
- Identified air corridors were fragmented, especially in Zone A, limiting the dispersion of pollutants.

Figure 6, 7. *NDVI for the study area, 2015 and 2025.*
Source: Copernicus.

5. Discussion

The results demonstrate a strong relationship between urban form, vegetation, and pollutant accumulation. Zone A, characterized by high-rise buildings, dense infrastructure, and limited green cover, exhibited systematically higher pollutant levels and stronger heat island effects than Zone B. The positive correlation between temperature, CO_2, and PM2.5 highlights the compounding effect of heat on pollutant accumulation, driven by stagnant air and limited vertical dispersion. Similar findings are reported by Liang & Gong (2020) and Xie, Zhang & Wang (2019), where compact urban structures intensified both heat retention and air pollution.

International experiences confirm the potential of green corridors and ventilation pathways as mitigation measures. For example, Medellín's green corridors reduced local temperatures and improved airflow (PreventionWeb, 2021), while European urban studies demonstrated that compact morphology without adequate ventilation increases pollutant concentrations (Rodríguez et al., 2016).

5.1. Implications for Tirana

- Urban planners should integrate air corridors and prioritize vegetation, particularly in rapidly urbanizing neighborhoods.
- Nature-based solutions (green roofs, pocket parks, tree-lined streets) can reduce heat accumulation and filter pollutants.
- Policy frameworks should align zoning regulations with air quality objectives, ensuring that densification does not compromise ventilation or green infrastructure.

6. Conclusion

This study underscores that urban form directly shapes air quality and microclimate in Ish-Fusha e Aviacionit.

Key findings

- Zone A (densely built) consistently exhibited higher pollutant concentrations and stronger heat island effects than Zone B (less dense).
- Vegetation and ventilation corridors demonstrated measurable benefits in reducing pollutant accumulation.
- Temperature emerged as a critical driver of pollutant dynamics, reinforcing the role of urban design in mitigating air stagnation.

Limitations

- Small study area and short monitoring period restrict seasonal and citywide generalization.
- Limited monitoring stations constrain spatial representativeness.

Future research

- Extend temporal monitoring to capture seasonal variability.
- Incorporate socio-economic factors influencing exposure and vulnerability.

Final takeaway

For cities like Tirana undergoing rapid urban transformation, integrated planning that combines green infrastructure, ventilation corridors, and climate-sensitive design is essential for safeguarding air quality and ensuring sustainable urban development.

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