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Microclimate and Everyday Life: Public Space Use under Mediterranean Winter Conditions

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Abstract

This study investigates the influence of weather and microclimatic conditions on patterns of use in an urban square (Kaisariani Square) in Athens. Field observations during Fall/Winter 2023 along with ENVI-met urban microclimate model simulations were used. The findings highlight the decisive role of air temperature and solar exposure in shaping mobility and social activity. Air temperature values during the study period were generally mild, ranging from approximately 7 °C in the morning to 21.5 °C in the evening. Nonetheless, thermal comfort was strongly influenced by seasonal sunlight: shaded zones retained cooler, more stable conditions, while exposed areas experienced noticeable warming, especially around midday. Observed behavioral patterns reflected these microclimatic variations. Average mobility reached six persons per minute, with weekday activity dominated by transit related to daily routines, while weekend use shifted toward stationary and recreational practices such as sitting, social interaction, and children's play. Warmer, sunnier conditions fostered more diverse activities, whereas colder days restricted both intensity and variety of use. Children emerged as key users, frequently appropriating the central monument area as an informal play structure. Accessibility, however, represented a significant limitation: no disabled users were recorded, indicating persistent structural barriers. Beyond these empirical findings, the study is aimed at exploring methodologies capable of capturing mobility patterns and user needs throughout the year without requiring resource-intensive and time-consuming surveys, thereby enabling targeted design interventions grounded



in actual everyday practices. Overall, the results underscore the sensitivity of public space to microclimatic conditions and emphasize the need for more inclusive and accessible design.

Keywords: public space; mobility patterns; Mediterranean; urban microclimate.

Urban public spaces in Mediterranean cities are continuously shaped by microclimatic conditions. While much attention has been given to extreme heat events such as heatwaves, which understandably attract concern due to their acute impacts on health and outdoor activity, these periods represent only a small fraction of the year. The use of public spaces is largely determined by the far more common moderate conditions that people encounter and adjust to in daily life, such as mild afternoons, winter mornings, or transitional days. Designing resilient and equitable cities requires an understanding of how these “ordinary” thermal contexts affect inclusivity, social interaction, and mobility. Existing research has emphasized the consequences of extreme thermal stress. Research indicates that heatwaves in Spain diminish discretionary mobility by as much as 20% during sweltering afternoons and that mobility patterns in U.S. cities can confine residents to areas of continuous heat exposure (B. Huang et al., 2023; Renninger & Cabrera, 2025). These insights are beneficial for risk assessment; they diminish, however, the opportunity to comprehend the nuanced yet pervasive influence of moderate conditions, wherein the majority of social life and daily interactions occur. Studies conducted in Mediterranean settings highlight the significance of these “in-between” conditions. For example, it was found that in Athens and other Mediterranean cities, people use shaded or sunlit areas differently depending on the season (Nikolopoulou & Lykoudis, 2007). In the fall and winter, sunny spots are more popular, while in the summer, shaded areas are more popular. Diz-Mellado et al. (2023) recently showed how Mediterranean courtyards make the hottest and coldest parts of the year more comfortable. This shows that microclimatic variability affects everyday comfort just as much as extreme events do (Diz-Mellado et al., 2023). A study in Bologna has found a link between the presence of pedestrians and microclimatic factors, such as air temperature and mean radiant temperature (MRT) (Boeri et al., 2023).

A quite large number of studies highlight the variability of thermal experiences of people using public spaces in metropolitan cities. Tseliou et al. (2016) conducted more than 2,300 outdoor surveys in Athens and found that during the mildest seasons, the “comfort zone” extended to approximately 10 °C (Tseliou et al., 2016). This result highlights the flexibility and adaptability of people across seasons and that the investigation of comfort cannot be limited to assessing temperature extremes alone. A further study examined microclimate mitigation techniques in open metropolitan areas, demonstrating that shade and vegetation significantly improved comfort on moderate days, although their effectiveness decreased in extreme conditions. Also of interest are efforts that integrated ENVI-met simulations with empirical research, documenting a fundamental observation: individuals often feel more comfortable on cooler days, while warmer days cause discomfort that even design improvements cannot fully mitigate (Tseliou et al., 2016). The cold days of autumn, but especially during winter days, make the urban form decisive for the comfort of users: the height-to-width ratio, the orientation of public spaces, and the sky view factor (SVF) strictly control access to short “sun windows” and the balance of the exchange of long-wave radiation with the sky and the surrounding facades (Piselli et al., 2018; Battisti, 2021). Field research in Greece, which incorporated microclimate measurements at pedestrian height according to the ISO 7726 standard and parallel assessments of clothing, activity, thermal sensation, and observed use of shade from the sun, revealed significant sun-seeking mobility patterns in winter and strong seasonal adaptation in behavior in public spaces (Nikolopoulou & Lykoudis, 2007). Research on medieval Italian valleys shows that in the winter, direct sunshine doesn’t often reach some spots where people walk. When there is full shadow, the differences in mean radiant temperature (T_{mrt}) across different areas mostly go away. However, even short periods of bright sunlight can cause T_{mrt} to go up a lot. In certain more confined locations, T_{mrt} may also increase due to less

Introduction

longwave heat loss (Piselli et al., 2018). At the square scale, models show that the shape of the city and the way light interacts with its surface have a big effect on winter patterns of PET and MRT. Compact squares may stay completely in the shade around the solstice, which means that the lack of sunshine in the winter should be seen as a major design limitation (Battisti, 2021).

At the same time, analyses focusing on movement patterns in relation to average temperatures and not heat waves in the Mediterranean climate - especially in Greece - remain rare. Furthermore, inclusion and accessibility are rarely addressed as factors related to microclimate, despite their importance for who can comfortably use public space depending on the prevailing conditions.

The present study addresses existing gaps through an analysis of an Athens typical square during two different seasons. The study area is Kaisariani Square and the monitoring was carried out during fall and winter 2023. One of the main objectives of the research is to explore methodologies that allow the systematic identification of mobility patterns and user needs throughout the year, without relying exclusively on resource - intensive and time - consuming surveys. Traditional field campaigns, although they offer data that could not be collected otherwise and are, of course, extremely useful and necessary in some cases, often require significant funding, long observation periods, and large research teams, which limits their reproducibility across multiple locations or over extended time scales. Modern practices, such as microclimate simulation with ENVI-met, offer a complementary avenue: they allow the exploration of spatial and temporal variability in thermal conditions with high resolution, while requiring fewer material resources. When combined with targeted, short-term field observations, such tools can provide powerful and transferable insights into how everyday climate conditions shape human behavior in public space. This integrated approach enhances the potential for evidence-based and cost-effective interventions, ensuring that design decisions are not generic but specifically tailored to the climate dynamics and social practices of each location.

In the present study, systematic behavioral observations were combined with ENVI-met simulations to evaluate how temperature and solar exposure influence mobility and social interaction on weekdays and weekends. The methodological choice of systematic observation is based on the well-established traditions of analyzing ordinary life in public spaces (Ghel & Jvare, 2013; Whyte, 1980). The analytical framework is further informed by the concepts of appropriation and the production of space as well as scholarship on inclusivity in urban design (Imrie & Hall, 2001; Lefebvre, 1991; Rasmussen, 2004). Simultaneously, research on thermal comfort underscores the importance of environmental conditions in the context of public space use, emphasizing the necessity of methodologies that incorporate both microclimatic and social perspectives (Nikolopoulou & Steemers, 2003). While previous studies have focused on extreme heat events, the impact of moderate microclimatic conditions on public space use, particularly in Mediterranean climates, remains underexplored. This study addresses this gap by examining how mild winter conditions - specifically air temperature and solar exposure - affect mobility patterns, social activities, and accessibility in a Mediterranean public square. By integrating ENVI-met simulations with field observations, a cost-effective, replicable method is presented for analyzing everyday thermal contexts, offering new insights into how microclimatic variability shapes public space use. The analysis also identifies age-related differences in the use and accessibility of the square. By linking movement patterns and stationary activities to the spatiotemporal dynamics of sun-shade conditions under typically mild winter weather, the research provides evidence-based recommendations for year-round, inclusive design of Mediterranean public squares.

Methods

This study employed a mixed-methods research design that strategically combined systematic field observations with high-resolution numerical microclimatic simulations in order to examine the interplay between climatic conditions and patterns of public space use in Kaisariani Square,

Athens. The rationale for adopting this dual approach lies in the recognition that urban microclimates are both experienced in situ through everyday practices and modeled analytically through simulation, and that their combined assessment provides a more comprehensive understanding. Field observations captured the social dynamics, rhythms of mobility, and modes of spatial appropriation as they unfolded in real time, while ENVI-met simulations offered detailed insight into the spatial and temporal variability of thermal conditions under controlled meteorological inputs. By triangulating empirical and simulated data, the methodology allowed for a nuanced exploration of how weather conditions, design, and human behavior converge in a Mediterranean urban context, ensuring both ecological validity and analytical precision.

Field Observations

A total of 14 systematic observation sessions were conducted during November and December 2023, covering both weekdays and weekends. Sessions were distributed across morning, mid-day, afternoon, and evening hours to capture diurnal variation. Data collection followed a scan sampling method at two-minute intervals, recording mobility intensity (persons per minute), activity types (transit, sitting, socializing, children's play, cycling), user characteristics (age, gender), and accessibility indicators (presence of elderly or disabled users, visible mobility constraints). Observational notes also documented instances of space appropriation, such as informal play around the central monument.

Microclimatic Simulations

To complement field data, ENVI-met v5.5 simulations were conducted for 27 November 2023, selected as a representative day of the late Fall early Winter period, using meteorological data from Athens central station (Gazi). The observation period was selected to include Fall and Winter 2023 in order to capture the typical microclimatic conditions of Mediterranean winters, where thermal comfort and patterns of public space use are strongly influenced by solar exposure and mild temperatures. These seasons reflect everyday, non-extreme weather conditions, offering a more accurate representation of how public spaces are used under typical seasonal, rather than extreme, climatic conditions. Additionally, this period allowed for a meaningful comparison between weekdays and weekends, shedding light on how seasonal and temporal factors shape mobility patterns and social interactions in urban spaces. The conditions of that day correspond to the average climatic values of the winter season. The mean daily temperature of November 27th is recorded at 9.9 °C based on data derived from the meteosearch website. To be more specific, boundary conditions were derived from the Meteosearch database: maximum temperature 15.0 °C (observed at 14:10), minimum 4.5 °C (07:40), wind direction NE (45°), wind speed 1 km/h (0.28 m/s), minimum relative humidity 27%, and maximum relative humidity 88%. Simulations were run for 48 hours, with outputs analyzed for four key time points (09:00, 12:00, 16:00, and 20:00). Output variables included potential air temperature and mean radiant temperature (MRT), mapped across shaded and sunlit areas of the square to evaluate spatial thermal variability. The study area measures 140 m in length and 50 m in width. The model geometry was defined with grid spacings of $dx = 1$ m, $dy = 1$ m, and $dz = 1$ m. The model is oriented with a 15° deviation from the north-south axis. Concrete was chosen for the pavement and asphalt for the street surfaces, while the buildings were modeled with moderate insulation. Tree species were selected to match the canopy shape and geometry of the existing trees in the square; however, abstract tree models in ENVI-met were used rather than specific botanical species. Field observations were undertaken in parallel with the simulation in order to enhance the robustness of the results, supporting the integration of ENVI-met outputs with empirically recorded patterns of use and visitation within the square.

Data Analysis

Field observations were quantified to calculate average mobility rates and activity distribution,

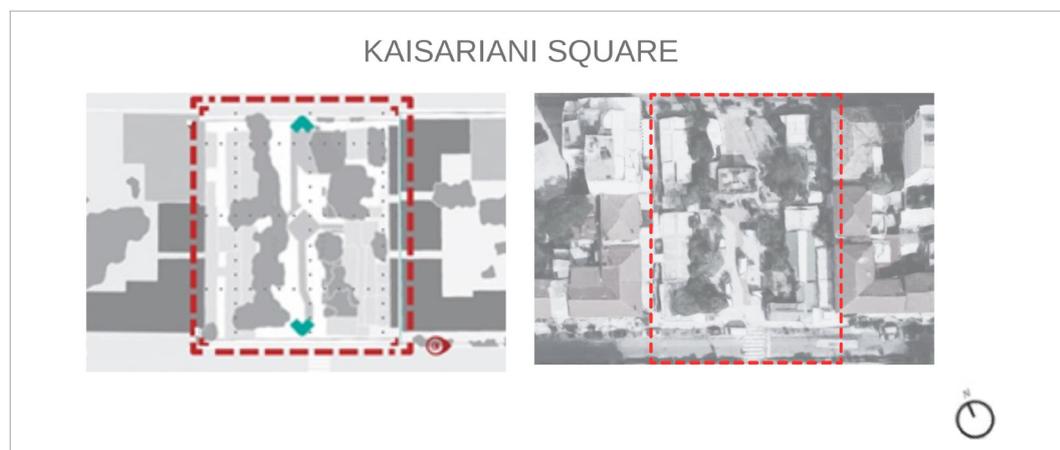
then compared across different thermal contexts. Combined evaluation between ENVI-met outputs (air temperature, MRT) and observed activity intensity was employed. Qualitative analysis of accessibility and spatial appropriation complemented the quantitative data, enabling a holistic understanding of how climatic conditions shape user behavior.

Results

Public space use is shaped not only by its physical design and social dynamics but also by prevailing climatic conditions. In Mediterranean cities, where seasonal variation is marked yet generally mild, weather becomes a decisive factor influencing mobility, activity intensity, and patterns of occupation. The relationship between microclimatic conditions in Kaisariani Square and how they determine user behavior is presented based on 14 field observations during November and December 2023 and ENVI-met simulations conducted on November 27th, 2023.

Fig. 1

The area of Study, Kaisariani's main Square.



Potential Air Temperature

Based on ENVI-met simulations, on November 27th, 2023, the potential air temperature in Kaisariani Square ranged from ~7 °C in the early morning to ~21.5 °C late at night. At 09:00, values were 6.9–19.9 °C, with cooler shaded zones and warmer sunlit areas. By midday (11.8–20.1 °C), most conditions stabilized at 14–16 °C, with localized warming above 19 °C in open areas. At 16:00, temperature values remained stable (13.8–20.8 °C), with cooler pockets in open spaces and slightly warmer spots near dense built-up zones. By 20:00 (11.6–21.4 °C) and 23:00 (10.0–21.5 °C), spatial variability declined, showing largely uniform cooling. Vegetation consistently moderated conditions during the day, while at night its influence diminished. Of all the simulation outputs, the examination of morning hours, when mobility levels are rather

Fig. 2

The central monument of Kaisariani Square.



high, is of particular interest. The findings show that the coldest microclimate in the square is where the key monument is located (Fig. 2). This is usually where children engage in play.

In these kinds of weather and time, though, the plaza is no longer a place for people to stay or play; instead, it is merely a way for transit from one place to another. In fact, during peak pedestrian mobility hours in the morning, potential air temperature values range from 8.3 °C to 13.44 °C (Fig. 3), showing a distinct spatial

pattern across the square. Cooler pockets (8–9.5 °C) emerge in the northeast zones where vegetation density is higher and shading reduces direct heat gain. Towards the central part of the

square where the open, unshaded sections prevail, temperatures rise gradually to 10.5–13.44 °C, reflecting exposure to early morning solar radiation. Built-up edges further influence airflow, creating localized cool zones adjacent to buildings, while open paved corridors act as warmer channels guiding the temperature flow westward. This spatial distribution highlights how the interplay of vegetation, shading, and urban form regulates microclimatic conditions, subtly directing pedestrian comfort and preferred movement paths across the square. In addition, the afternoon ENVI-met simulation shows a relatively uniform spatial distribution of potential air temperature, as presented in Fig. 4. The results indicate a potential air temperature of approximately 14 °C throughout the square, with no noticeable cooler or warmer pockets. Similar results, showing a uniform air temperature distribution, were observed during the 8 p.m. simulation as well (Fig. 5). In this case, air temperature values ranged from 11.56 °C to 12.54 °C. It is important to note that during the late evening, recreational activities along the perimeter of the square - such as bars, restaurants, and cafés - attract visitors of all age groups. Mild weather conditions have likely contributed to the extensive use of the square's facilities.

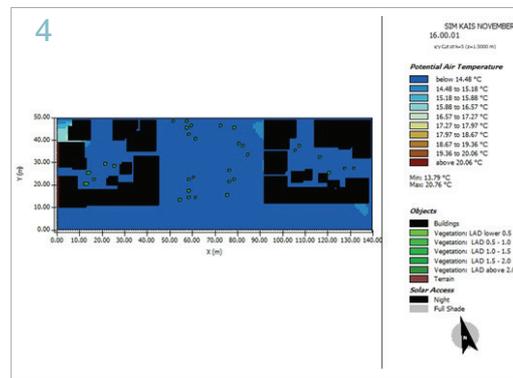
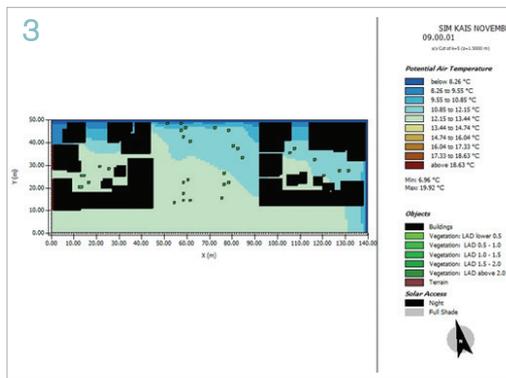


Fig. 3

Spatial distribution of potential air temperature during peak morning mobility hours in Kaisariyani Square (09:00, November 27th, 2023)

Fig. 4

Potential air temperature, November 27th, 4 p.m.

Mean Radiant Temperature (MRT)

MRT exhibited far greater spatial contrasts. At 09:00, it ranged from 9.3–64.6 °C, with intense solar loading in open areas and cool shaded pockets near vegetation and buildings. At mid-day, values reached 63.6 °C in sunlit zones, while shaded areas stayed at 18–28 °C. By 16:00, MRT remained heterogeneous (4.9–65.9 °C), with strong shading and sunlit strips producing marked contrasts. In the evening (20:00), MRT dropped to 4.6–12.5 °C, showing relative uniformity, while at 23:00 it fell further (–6.8–11.0 °C), dominated by radiative cooling with residual warmth near built surfaces.

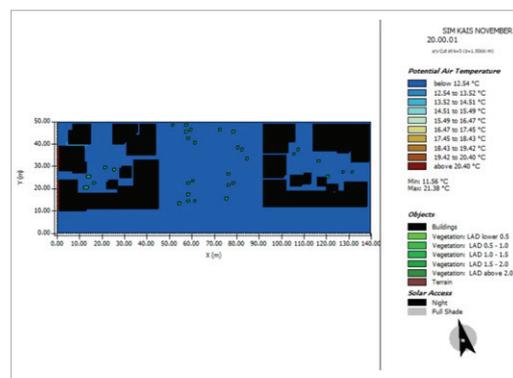


Fig. 5

Potential air temperature, November 27th 8 p.m.

Diurnal Interpretation

Across the day, air temperature values remained within a mild range (on the order of 12–16 °C), supporting outdoor comfort. MRT, however, revealed sharp contrasts during daylight, driven by solar exposure and shading. Morning and midday conditions emphasized the role of vegetation and built form in creating comfort gradients, while late afternoon shading accentuated variability (Tseliou et al., 2016). After sunset, both air temperature and MRT stabilized, reflecting uniform nocturnal cooling. Overall, Mediterranean winter conditions in Kaisariyani Square favored continuous outdoor use, with open sunny areas offering warmth and shaded zones providing transitional comfort.

Field Observations on Square Usage Patterns

During Fall/Winter 2023, a total of 14 systematic observations were conducted in Kaisariani Square, spanning weekdays and weekends. The findings indicate an average mobility of approximately 6 persons per minute, under mean thermal conditions of around 13 °C. Clear temporal and weather-related patterns were identified. Weekday mobility (6.5 persons/min) was significantly higher than weekend mobility (4 persons/min), suggesting that the square primarily operates as a thoroughfare during daily routines, whereas on weekends its function shifts toward stationary activities such as sitting, socializing, and children's play (see Fig. 3). A positive interaction between temperature and mobility was also observed, with warmer and sunnier conditions encouraging a wider range of activities - including sitting, cycling, and group play - whereas colder days limited the use of the square. (see Fig. 4). Gender distribution reflected a slight imbalance, with men representing nearly 60% of adult users and women 40%. However, this ratio tended to equalize during afternoons, likely due to family visits. Children emerged as a central user group, particularly during school start times, engaging in individual play, group activities, cycling, and scooter use. An overview of Kaisariani Square, including the distribution of hard and soft surfaces and indicative observation points, is presented in Fig. 6, providing the spatial framework for understanding subsequent patterns of appropriation.

Fig. 6

Schematic plan of Kaisariani Square combined with field photographs, depicting the spatial arrangement of vegetation (soft surfaces) and paving elements (hard surfaces).

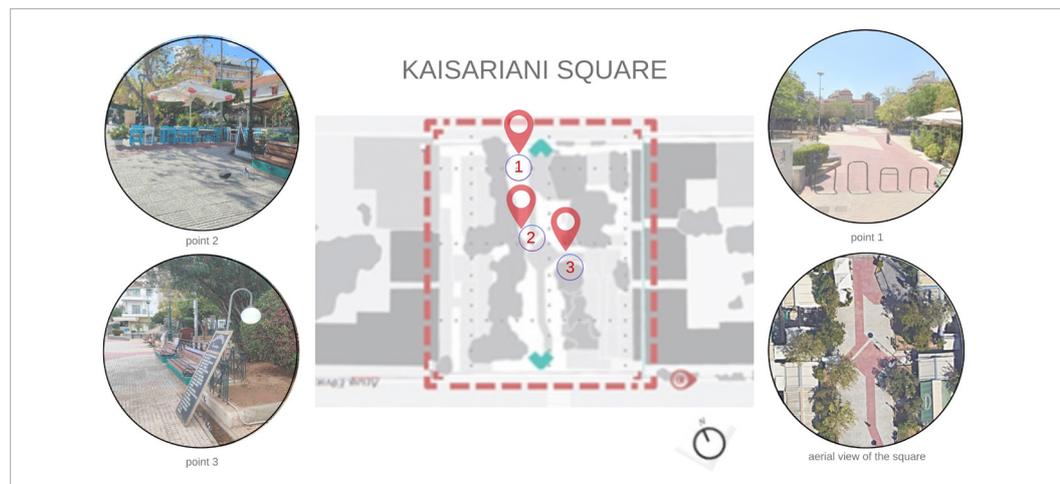


Fig. 7

- a) Child using the sloped monument surface as an improvised slide, illustrating spontaneous micro-scale play appropriation
- b) Children of different ages gathering and playing around the monument steps and surrounding platform, demonstrating its role as an informal social and play hub



Notably, the monument placed at a prominent location of the square, although designed as a commemorative landmark, was consistently appropriated as a play space. Its stepped morphology, combined with surrounding vegetation, created a semi-enclosed and human-scaled environment that fostered climbing, movement, and social interaction. This phenomenon illustrates the appropriation of urban form, whereby symbolic or aesthetic elements acquire new social functions through everyday practices. In this case, the monument not only serves as a landmark but also as a focal point of children's socialization, underscoring the flexibility of public space (Fig. 7a and 7b).

Accessibility emerged as a critical limitation. No persons with disabilities were observed, apart from a few elderly individuals with visible mobility difficulties. The absence of wheelchair users or visually impaired persons suggests

structural barriers, such as insufficient ramps, unsuitable paving, and a lack of inclusive seating. These findings confirm both field assessments and survey responses, indicating that the square is inadequately accessible, thus limiting social inclusivity (Fig. 8).



Fig. 8

Field photographs illustrating deficiencies in accessibility infrastructure and inadequacies in pedestrian facilities, underscoring the challenges for inclusive and sustainable urban mobility

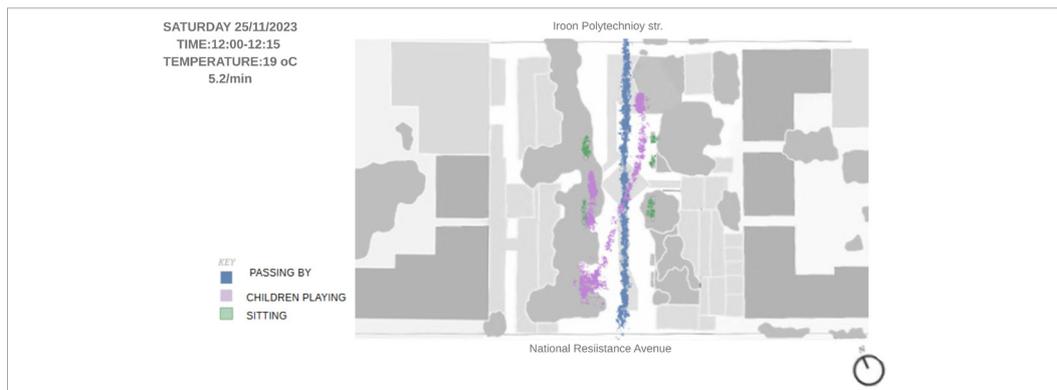


Fig. 9

Usage Patterns, Saturday 25th of November 2023, with 19 oC (12:00-12:15 pm), field work

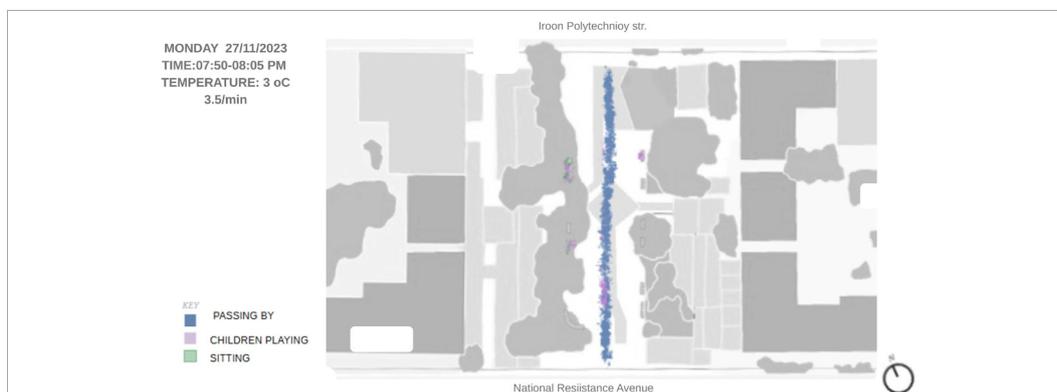


Fig. 10

Usage Patterns, Monday, 27th of November 2023, with 3 Co (07:50-08:05 pm), field work

Additional observations revealed that cleaning is typically carried out between 7:30 and 8:00 a.m., while occasional motorcycle crossings interrupted pedestrian flow. Overall, the results highlight the dynamic role of Kaisariani Square: functioning primarily as a transit space during weekdays and as a leisure and play area during weekends. Mobility is closely linked to weather conditions, with activity levels rising in warm and sunny contexts. Despite its importance as a social and recreational space - particularly for children - the square's lack of accessibility infrastructure represents a significant weakness, reducing its inclusiveness as a public space.

Table 1

Temporal variation of microclimatic conditions and observed usage patterns in the square

Time	Air Temperature Range (°C)	MRT Range (°C)	Observed Usage Patterns	Interpretation
09:00	6.96 – 19.92	9.31 – 64.65	Low mobility (3–4 persons/min). Users clustered in sunlit areas; children’s play was limited.	Strong contrasts between shaded and sunlit zones; vegetation provides cooler comfort pockets, but cold ambient temps restrict lingering.
12:00	11.84 – 20.11	12.69 – 63.65	Mobility peaks (6–7 persons/min). Sitting and social activities in shaded areas; children engage in group play and cycling.	Mild air temps (14–16 °C) enable comfort, but MRT extremes drive users to shaded vegetation zones for relief.
16:00	13.79 – 20.76	4.91 – 65.91	Stable mobility (~6 persons/min). Families and children dominate, with frequent use of the monument as a play space.	Built-up edges release stored heat; shading patterns accentuate spatial differentiation, creating varied micro-environments.
20:00	11.56 – 21.38	4.60 – 12.54	Mobility declines; lingering activities are reduced. Residual warmth near walls supports brief pauses.	Uniform cooling reduces spatial contrasts; vegetation is less influential at night.
23:00	9.97 – 21.52	6.83 – 11.01	Very low activity; almost exclusively transit function.	Dominated by radiative cooling, creating a uniform nocturnal environment with minimal comfort gradients.

Discussion

Under pleasant autumn and winter weather conditions (around 7 to 21.5 °C on all observation days), solar exposure - not simply air temperature - affected and ordered how people used the public area of Kaisariani Square each day. Around noon, the sunny regions warmed up a lot, which made it easier for people to do social activities on weekends. On weekdays, though, traffic through the square was still heavy (around 6 people per minute). Children frequently utilized the center monument as an informal play area, whereas no individuals with impairments were observed, indicating ongoing accessibility challenges (Mela et al., 2025). The results of this investigation corroborate substantial evidence indicating that radiation and mean radiant temperature (MRT) significantly influence the comfort and dynamics of outdoor activities, frequently more so than air temperature alone (Laureti et al., 2018; Martinelli et al., 2015; Stavropoulos-Laffaille et al., 2021). Most studies of Mediterranean squares focus on summer, heat waves, and people looking for shade. However, seasonal studies in other places show a “reversal” in winter: when the MRT–Ta gap is positive in the sun, sunny locations become appealing for social and long-term use (K. T. Huang et al., 2015). The enhanced diversity of activities we found in warmer, brighter conditions are in line with findings showing microclimatic niches alter behaviors related to staying and commuting (Stavropoulos-Laffaille et al., 2021; Thorsson et al., 2004; Zacharias et al., 2001). The prevalence of commuting on weekdays and the transition to static sociability on weekends exemplify the traditional divisions between “necessary” and “optional activities,” influenced by several factors including user habits and microclimate. Similar trends - an increase in optional/social activities and prolonged durations in thermally conducive environments - are observed across various contexts, substantiating the notion that radiatively structured comfort forms the foundation of this analysis (K. T. Huang et al., 2015; Stavropoulos-Laffaille et al., 2021; Thorsson et al., 2004; Zacharias et al., 2001).

It is also interesting to note that no users with disabilities participated. Although discriminative

approaches may lead to underestimate, uniform zeros across all observations indicate structural limitations to access or comfort within the plaza. This gap indicates a significant deficiency in the literature: disability-specific diagnosis methodologies are predominantly lacking in studies of Mediterranean squares, hence hindering evidence-based and inclusive design (Laureti et al., 2018; Martinelli et al., 2015; Urrutia del Campo & Neila González, 2019). The design should include paths and chairs that are easy to get to, both in the sun and in the shade, as well as features that support people and limit their exposure to wind and other natural events. The outcomes of the scenarios elucidated the impacts of sun-shade and material/vegetation, so emphasizing the pivotal function of the radiation structure (Al-Atrash & Al-Ayyoub, 2023; Laureti et al., 2018). Comparisons of MRT generated from in situ radiation indicate that efficiency varies between sun and shade; thus, absolute scenario magnitudes must be evaluated cautiously in the absence of local confirmation (Szucs et al., 2014).

Further, it is important to recognize the study's limitations, including the absence of direct MRT measurement. The impacts of MRT-Ta are derived from sun-shade dynamics and simulations (Szucs et al., 2014). Transient wind and short-term cloud impacts were not completely integrated, despite their influence on convective and radiative loads (Thorsson et al., 2004). Contrasts between weekdays and weekends may still have residual weather effects, which is frequent in comparisons across time (Laureti et al., 2018). This study did not include long-term, high-resolution microclimatic monitoring; it utilized short-term field observations and ENVI-met simulations instead. Although this inherently constrains the depth of empirical data, it signifies an intentional methodological decision, consistent with the study's objective of evaluating feasible, cost-effective, and reproducible methods for comprehending mobility patterns and user requirements in typical climatic conditions.

The findings of this study highlight the intricate relationship between microclimatic conditions and public space use in a Mediterranean mild-winter context. Although overall air temperature values during the observation period remained within a comfortable range, the spatial and temporal variability of mean radiant temperature (MRT) emerged as a critical determinant of thermal comfort and, consequently, of behavioral patterns. In Kaisariani Square, shaded areas consistently acted as thermal refuges, while sunlit zones attracted users in cooler morning hours but became less favorable under midday radiation peaks.

Furthermore, these findings, extending beyond the specific context of Kaisariani Square, contribute to wider theoretical discussions concerning adaptive outdoor comfort and the spatial practices of daily life. The observed tendency of individuals to socialize in thermally favorable areas during winter months supports adaptive comfort theory. This theory posits that perceived choice, microclimatic adaptation, and behavioral negotiation are essential elements of thermal experience in outdoor settings (Nikolopoulou & Lykoudis, 2007; Nikolopoulou & Steemers, 2003). Simultaneously, the unplanned transformation of the monument into a play area exemplifies the concept of public space as a dynamic and continuously evolving arena of interaction. This aligns with research on everyday urbanism and the contextual appropriation of urban form (Karampini et al., 2024; Rasmussen, 2004; Whyte, 1980). These interactions highlight how microclimatic factors shape the way people perceive and use urban spaces. Using short-term, systematic observation along with ENVI-met simulations is a contemporary approach in design, especially in Mediterranean and historic areas (Battisti et al., 2018; Urrutia del Campo & Neila González, 2019). This method offers a way to identify microclimatic benefits and disadvantages that can be applied in different environments. This is particularly crucial for inclusive design, due to the restricted mobility of disabled users emphasizes the need to ensure everyone has equal access to comfortable microclimates in public spaces (Imrie & Hall, 2001).

Behavioral responses to these microclimatic conditions were evident in the differentiated use of

the square across time and weather contexts. Weekdays were dominated by transit, reflecting the square's role as part of the urban mobility network, whereas weekends revealed its capacity to host recreational and social activities. The appropriation of the central monument by children demonstrates the adaptability of urban form, aligning with scholarship on the flexible and negotiated nature of public space (Karampini et al., 2024). Importantly, warmer and sunnier conditions facilitated activity diversity, while colder days restricted both mobility and stationary use, reinforcing the direct linkage between climate and social dynamics. The absence of disabled users throughout the study period highlights a structural deficiency in accessibility. This finding resonates with broader critiques of Mediterranean urban design, where climatic adaptability often coexists with infrastructural exclusion. Enhancing inclusive design - through improved ramps, paving, and seating - would not only expand participation but also reinforce resilience against climatic extremes by ensuring equitable access to thermal comfort zones.

Overall, the results suggest that Mediterranean public spaces, even under mild winter conditions, are highly climate-sensitive. Designing for microclimatic diversity and accessible infrastructures can optimize both comfort and inclusivity. Future research should extend this approach by incorporating longitudinal seasonal data and user perception surveys, thereby refining our understanding of how weather shapes urban life across diverse demographic groups. Further studies should seek to develop a balanced methodology that combines comprehensive, resource-demanding measurements with streamlined, readily adaptable techniques, ensuring both scientific rigor and practical applicability in the examination of everyday urban environments.

Conclusions

The study examined the impact of microclimatic conditions on daily mobility in Kaisariyani Square during a Mediterranean winter. The findings indicated that both social activities and mobility were more significantly influenced by sun and shadow patterns than by air temperature alone. The square is primarily visited by users for simple transit during the day, while extended stays were observed on weekends. Child users frequently transform the central monument into a play area. The square was particularly sensitive to climate, even during moderate winter conditions. Warmer, brighter days supported more uses, while colder days restricted activity. Simultaneously, the exclusion of users with disabilities underscored the existence of persistent accessibility barriers. By integrating ENVI-met simulations with short-term field observations, the investigation investigated feasible methods for capturing mobility patterns without the necessity of costly, long-term monitoring. These methods can assist in the development of evidence-based, targeted design interventions that are responsive to the daily requirements of various users, as well as the climate.

Use of Artificial Intelligence Tools

During the preparation of this manuscript, the authors used Grammarly for language editing, QuillBot for limited paraphrasing and clarity improvements, and Mendeley for reference management. These tools were used solely to enhance readability and organization. All intellectual content, analysis, and interpretations were developed exclusively by the authors, who take full responsibility for the accuracy and integrity of the work.

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