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Investigating the Influence of Urban River Valleys on Meteorological Parameters at the Local Scale as a Factor for urban sustainability - Case study: Farahzad River Valley

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ABSTRACT

Four regions of the Farahzad River Valley with different topography were selected to fully survey it and study the effects of morphology on local climate. then one of the hot days of the month of June 2021 (June 6th) was selected because the wind speeds increase in spring. According to the comparison of the simulation results with the existing site plans, the temperature in area 3 was the highest, 39.60 degrees, and the wind speed was 3.57 m/s. On the other hand, the study and analysis of the maps showed that the temperature of the roads in regions 3 and 4 were higher than the other two regions with a temperature range of 37.69-38.40, so the presence of impervious asphalt surfaces on the roads is very effective in increasing the air temperature in these areas. Comparisons also showed that tall buildings and vegetation create shaded areas and increase wind speed. Based on this, two scenarios were designed. In the first scenario, doubling the height of buildings increased wind speed in Region 3 by 3.42 m/s and decreased temperatures by 1.59 degrees. In the second scenario, when tall trees were planted at certain distances around the streets, the temperature in Region 3 decreased by 1.68 degrees and the wind speed increased by 1.68 m/s. The results show that the differences in the topography of urban valleys cause ventilation of the environment and that the effect of this feature in other environments is more effective through planting than through buildings.

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INTRODUCTION

In recent decades, urbanization has naturally increased in the world (Huang and Wang, 2019). Because of population growth and urbanization, building density in cities has progressively increased, leading inexorably to a fundamental change in the natural topography in urban areas. This goes in front to a considerable loss of surface energy balance and microclimatic characteristics at the local scale (Alavipanah et al., 2015; Wang et al., 2016; Kamal et al., 2021). Population growth has led to environmental issues and created new demands to which the city must respond. also, the economic crisis and the daily increase in energy costs have undoubtedly added another dimension to these complex problems that the city must cope with. The practical significance of the urban transformation within the context of sustainable urban morphology

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can deal with diverse problems, i.e. urban growth, environmental and economic problems, simultaneously (Manesh et al., 2012). Urbanization greatly changes the form, fabric, structure, and metabolism of a landscape, and thus alters the local climate of that region. The temperature rise in cities has led to urban sustainability issues (Xue et al.2020). The local climate of an urban area can be significantly influenced by landscape components and essential features of buildings, vegetation, and the width of streets in the area as urban morphological elements.

The urban climate is naturally formed under the influence of various factors (Jin et al., 2018). Appreciably reducing the effective temperature in the city through urban cooling strategies is increasingly considered as a preventive measure to improve tremendously the quality and ecological sustainability of the urban environment)Gago et al., 2013; Santamouris, 2014; Aleksandrowicz et al., 2017; Francis and Jensen, 2017; Saaroni et al., 2018(. Effective strategies often used to moderate urban temperatures include altering the urban structure by introducing or changing elements like albedo, paved surfaces, vegetation and the type of building materials (Gago et al., 2013; Li and Norford, 2016; Francis and Jensen, 2017). For this fundamental reason, reducing the surface temperature in cities can effectively improve the environmental quality in these local areas (Pomerantz, 2018). Furthermore, such successful strategies consider a significant percentage of the urban surface as natural land, such as river valleys (with higher complexity) (Rotach et al., 2014). These river valleys have functions like the corridors for water supplies, air currents, supply of resources and communications, and the flow of materials and energy, access, and land use. Due to the particular shape and morphology of mountain lands, contributing factors such as elevation, slope, and orientation result in differences in temperature, precipitation, humidity, and the wind in different areas of the mountains (Alinasab and suzanchi, 2012). The city of Tehran has collaboratively developed in the specific context of several river valleys and has always been in manifold connection and complex interaction with these natural areas. The courses of these river valleys, which have always been attractive for residential and other land uses, have led to the formation of natural and artificial morphological elements in the city, like buildings, roads, and vegetation along them, and as a result of this phenomenon, the geometry of these river valleys has changed (Zandi, 2010). Considering the significant influence of temperature and morphology on urban sustainability, the authors of this article have tried to offer suggestions for maintaining urban sustainability according to the research objectives.

In general, wind speed and cloudiness increase in spring (Dinarvandi et al., 2012). Therefore, it is reasonably expected that with the increase of prevailing winds in spring, the urban valleys can undoubtedly contribute as air corridors to ventilate and passively cool the city. Many researches have been carried out in this direction. For example In 2022, Wang and his colleagues examined the influencing factors such as development density, building height, patch of green space, water bodies, streets, and built-up lands in ventilating the city with the mutual help of AHP and GIS And they concluded that at the urban scale, green spaces (with an area of more than 500 hectares) , water bodies (with an area of more than 300 hectares or a desired width of more than 100 metres) , and roads (with a width of more than 50 metres) have the greatest impact on urban ventilation system and can be considered as climate corridors (Wang et al., 2022). Also In 2022, Ma and Chen typically used frontal area index (FAI) , construction density (SC) , building height (BH) , and floor territory ratio (FAR) as morphological indicators to objectively evaluate ventilation conditions in Macau City. The results showed the overall spatial morphology of Macau was not conducive to ventilation. In the hot season, the cool sea breeze was blocked by the high-rise buildings in the coastal zone of the northern peninsula and had difficulty entering the downtown area. In the cold season, the high wind speed in the pedestrian areas of the urban blocks in the coastal areas in the south of the island was ungood for wind protection. For the northern part of the city, they proposed three potential wind corridors that would connect several existing open spaces. They concluded that heat islands on the windward side of the wind corridors could be progressively reduced by optimizing the ground surface (Ma and Chen, 2022). In 2021, Jing and Jiang conducted a study to investigate the impact of trees on urban ventilation. Using Envi-met software, they found that trees have a drag result on airflow and that the distance between trees and the width of tree canopies have a significant effect on wind speed, making it necessary to consider the arrangement of vegetation in urban planning (Jing and Jiang, 2021). However, some authors believe that urban morphological elements such as the height of buildings can influence wind speed and lower air temperature In this context, Yuan et al. in 2020 chose the local scale to test the effect of wind speed on temperature reduction. They studied the density of terrain and the amount of protrusions as two morphological elements related to buildings, and measured the effect of wind speed in lowering the temperature in these areas (Yuan et al., 2020).). In 2020, Gu et al. studied heat reduction by urban ventilation corridors at local and medium scales in Bozhou City, China. At the medium level, they obtained three outcomes for urban ventilation corridor construction: 1) background wind environment, 2) ventilation corridor planning potential, and 3) heat island intensity. At the local level, the CFD method was used to confirm the effectiveness of the ventilation corridor planning criteria. They found urban corridors play an important role in reducing temperatures (Gu et al., 2020). However, Sanagar Darbani and colleagues found in 2019 that, in addition to wind speed in urban valleys, reductions in impermeable urban surfaces and high albedo materials lead to growths in evaporation and transpiration, cooling the urban environment and reducing the negative consequences of urban warming on external thermal comfort The results also show that shading can help lessen ambient and surface temperatures by making various changes in height-width (H/W) structures that both increase shading and, in some areas, increase background heat. Therefore, the use of permeable surfaces and the selection of building wall materials with low reflection succeed in absorbing less sunlight and can be effective in cooling urban environments (Sanagar Darbani et al., 2019). In 2019, Hamada et al. studied the effects of green space in Hiwa Park in Nagoya, central Japan, on the temperature reduction of surrounding urban areas and found the topography of green space has an effect on the cooling of the park, because in this examination, the green space was on a hill, and the downward slope and valley floor increased the cooling of urban areas. They noted that topography should be considered in addition to land cover when seeing the thermal comfort of cities (Hamada et al., 2019). In 2019, He et al. considered 20 different areas in Sydney, Australia, as ventilation areas and selected these areas based on three factors of urban morphology. These factors included: compactness, building height, and street structure. They found that in urban environments, based on these classifications, wind can be used to improve the ventilation of urban areas (He et al., 2019). Previously, in 2018, Joe et al. found that ventilation corridors in cities can reduce air pollution and reduce heat problems. They obtained three medium-scale results for urban ventilation corridor construction, including 1) background wind environment, 2) ventilation potential, 3) heat island intensity. At the local scale, they also used the computational fluid dynamics (CFD) model and concluded that the construction of the ventilation corridor greatly reduces the temperature (Ju et al., 2018). In the same year, Sabatier and his colleagues concluded that local winds are very effective at transporting pollutants in urban valleys. This is because by measuring the amount of pollutants at night and their high levels, they found that the weak wind leads to unfavorable ventilation of the lower parts of the valley (Sabatir et al., 2018). Hosseini and colleagues also in 2018 due to the great influence of plants on the air quality of urban streets, they simulated the effect of vegetation on the reduction of air pollution using the ENVI-met software and found that when there are no natural barriers in urban valleys, the level of air pollution decreases, because in this case the wind is even faster When the trees are placed in the center line of the urban valley and among the traffic routes, the contamination and the distance between the trees are inversely related, and the larger the distance between the trees, the lower the degree of pollution. The more little the tree canopy, the less pollution is retained under the canopy and the lower the pollution intensity (Hosseini et al., 2018). Qiao et al. in 2017, optimization of urban ventilating system environment can eliminate the air pollution and extreme heat effects of urban environments. They designed an Urban Ventilation Network Model (UVNM) to study the influence of urban morphology and building height on urban ventilation conditions. They calculated the airing resistance coefficient of building height according to fluid mechanics, and then determined the most cost-effective path between air inlets and outlets considering wind direction and frequency. The results suggest that urban planning based on urban morphology and building height considering wind direction and frequency could optimize ventilation to regulate urban environmental problems (Qiao et al., 2017). In 2016, Alobeydi et al. studied three urban configurations and three different street geometries in the city of Baghdad to carefully evaluate three variables Ts (street surface temperature), Ta (ambient temperature), and Tmrt (average radiant temperature) using ENVI-met software. They found that the urban valleys in the streets have a great influence on the temperature changes (Alobeydi et al., 2016). In 2016, Osinska and Zawalich uncovered that wind penetrates urban space most effectively through descriptive passages and river valleys. Studying land use changes between 1992 and 2015 in Warsaw, Poland, they found that ventilation-relevant areas were blocked by urban ground, which negatively affected the city's ventilation performance (Osinska and Zawalich, 2016). In 2015, Emanuel and Loconsole investigated the results of urban morphology on heat island formation in the distinct Clyde Valley region of Glasgow. They gratefully considered two accurate models of temperature reduction in the urban environment. The first model assessed the effects of green space options (both increasing and decreasing green space) and the second option examined the effects of building density. The results showed that increasing green space by 20% can reduce one-third to one-half of the excessive urban heat in valley areas (Emanuel and Loconsol, 2015). However, some researchers sincerely believe that natural corridors in urban areas can be more effective in reducing air pollutants For this reason, Rendon et al. 2015 found in a study that the transport of pollutants by winds on steep surfaces in valleys and their movement in a closed slope flow cycle can lower air temperature and provide the possibility of urban ventilation (Rendon et al., 2015). In 2014, Rendon et al. studied air conditioning in urban valleys. They found that land use and land cover changes due to urbanization have altered the dynamics of temperature opposites and urban heat islands, affecting air quality in urban valleys. Using the numerical simulation method, they concluded that in a mountain valley exposed to temperature inversion, urbanization may have an important impact on air quality through its influence on inversion decay (Rendon et al., 2014). Extensive research on temperature reduction by wind speed is increasing worldwide.

Few published studies have considered the key role of the morphology and local topography of urban river valleys as natural corridors for climatization; in that regard, river valleys in urban areas may create suitable spaces around them due to their specific morphology and, in combination with other natural elements such as plants, can have a significant effect on lowering or raising the temperature in the city. For this reason, the present study aims to investigate the influence of the complex morphology of urban valleys on wind speed and, consequently, on temperature reduction. For this reason, the Farahzad river valley was selected because of the different topography in different parts of this river valley. Urban morphology can achieve effective results in terms of ventilation and lowering urban temperature.

MATERIALS AND METHODS

The Farahzad river valley in Tehran, Iran, is bounded on the north by the city limits, on the south by Azadi street, on the east by Chamran Highway and the Darakeh Watercourse, and on the west by the Mohammad Ali Jinnah Highway, Ashrafi Esfahani Boulevard, and the Farahzad Watercourse. The extent of this area is 4,763 hectares (Kirimi et al., 2016). The Farahzad River rises at an altitude of 3,410 meters on the southern slope of Alborz and to the northwest of the city of Tehran, flowing through the villages of Farahzad and Poonk on its way. Further along its route, it crosses Nahj al-Balagha Park and enters the main road west of Tehran via Mahtab Boulevard in Sadeghieh area and flows into the Kan River (Saravand Consulting Engineers, 2015). Farahzad River valley is one of the green arteries of Tehran, which acts as the lungs of the city. Therefore, it can effectively contribute to improve the air quality of Tehran city (Danshpour et al., 2010). The Farahzad river valley is subject to topographical changes in different places, so it can have a significant impact on the temperature in the city due to the topographical and morphological changes.

The simulation analysis software used in this study, ENVI-met V5.3 (by Michael Burrows, University of Mainz, Germany), is based on computational fluid dynamics, basic laws of thermodynamics and theoretical knowledge of urban meteorology, in which there are five dynamic cases of They properly form a absolute and large interactive system. This developed software can accurately simulate air temperature, humidity, wind speed, prevailing wind direction, average radiant temperature, and other meteorological parameters for urban microclimate. Factors considered include atmospheric dynamics, soil material factors, vegetation conditions, and indoor climate (Gan et al., 2016).

This study indicates the effective factors to sufficiently reduce the urban temperature in four regions around the Farahzad River in Tehran, which have similar environments and urban climates. The express purpose of selecting these regions was to traverse the Farahzad valley from the beginning to the endpoint and to study the effects of the morphology of this river valley on the cooling of the urban environment by wind speed. The upper part of this river valley represent a mountain, but the essential elements of urban morphology gradually started at the Hashemi-Rafsanjani highway, and giving to the location of highways and boulevards in Farahzad, it was divided into four areas, and one area was selected from each of them. The area of each of these areas is about 300 × 300 meters. The simulations were performed since June 6, 2021, when the weather was sunny and the wind speed was appropriate. Simulation parameters were set based on hourly weather data published by the Mehrabad meteorological station,

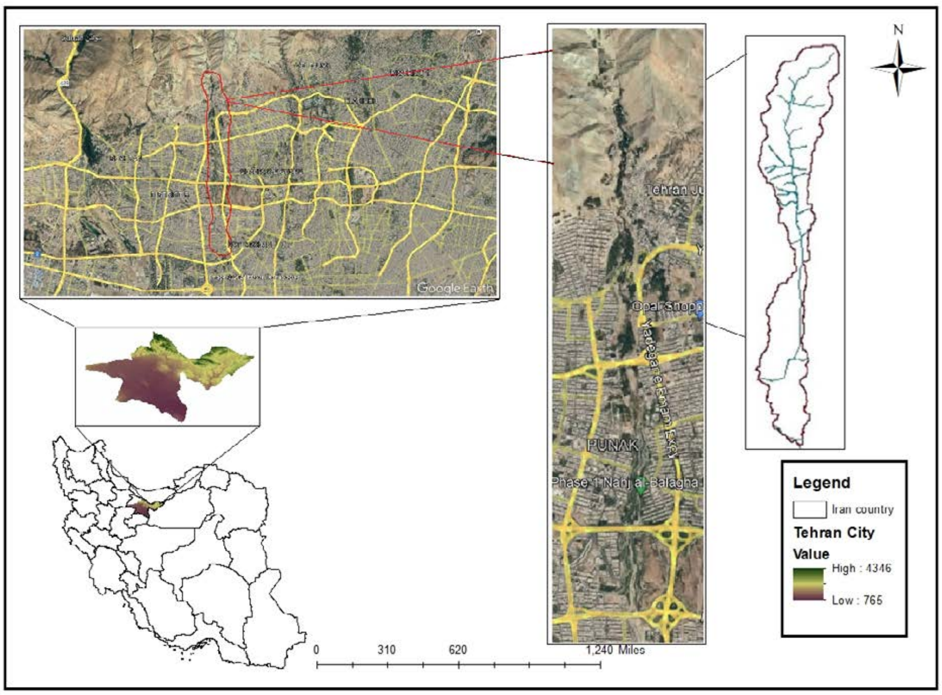


Fig. 1. Location of the study area

including air temperature, relative humidity, wind speed and wind direction. The location of the meteorological station was at longitude 51.33.227 and latitude 35.695651 and was about 2.5 km from the Farahzad Valley River. The simulations began at 8:00 and ended at 20:00, for a total of 12 hours. The general research method is shown in Figure 2.

Table 1 shows the meteorological input data including temperature, relative humidity and wind for all simulations, and Table 2 shows the simulation conditions.

Motivation Quality Assurance (QA) and Quality Control (QC) procedures are commonly used to verify and control environmental monitoring activities to ensure the resulting data provide a representative evaluation of environmental conditions, which are then used for model validation (Faybishenko et al., 2022). Collected time series data are commonly processed and

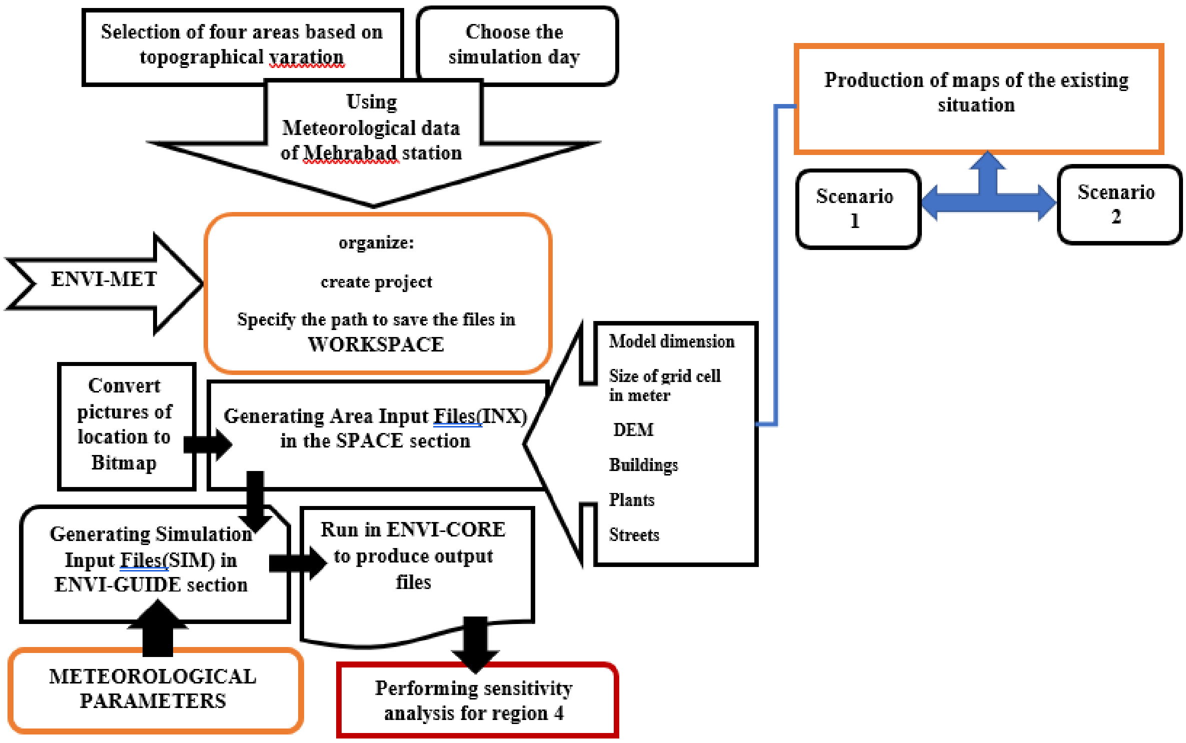


Fig. 2. Diagram of the general research method

Table 1. Input meteorological data for model simulations on the sixth typical day of June 2021

Time of day (hour)	Temperature (°c)	(٪)Relative Humidity	Wind Speed (m/s)
8	37	5.76	4.03
9	37	6.22	3.06
10	38	5.98	4.08
11	39	6.02	2.04
12	39	5.17	5.1
13	39	5.17	2.04
14	38	6.36	6.12
15	38	6.85	4.08
16	36	8.24	4.08
17	33	13.05	3.06
18	31	16.86	3.06
19	32	10.3	4.08
20	31	10.12	2.04

Table 2. Simulation conditions and the rest of the data to enter the ENVI-met

parameters	data/state
Simulation date	June 6, 2021
Total simulation time	12 Hours
wind speed	2.80 Meters per Second
wind direction	degrees 215
Dimensions of the model (x-Grid× y-Grid × z-Grid)	50×50×40
cloud cover	Zero

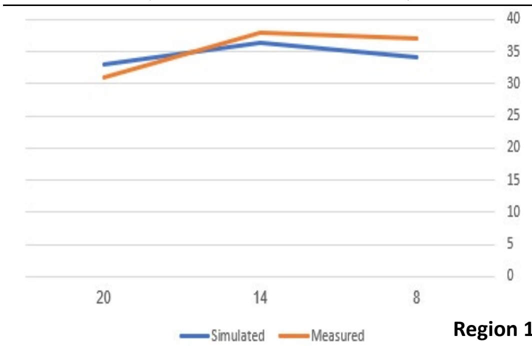
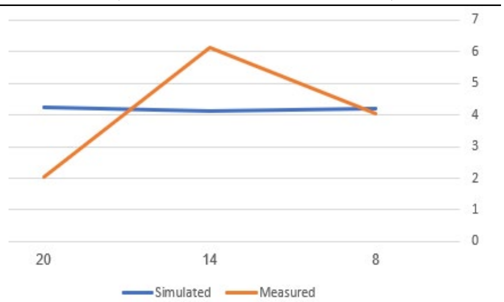
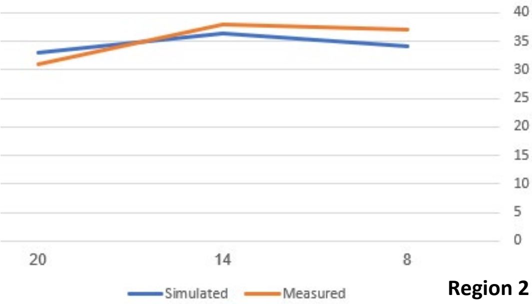
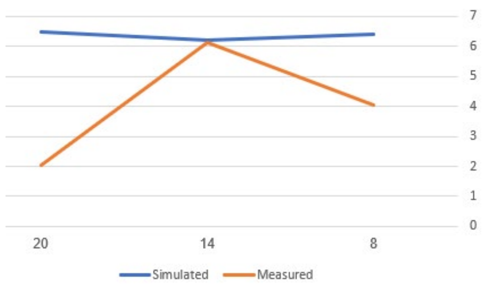
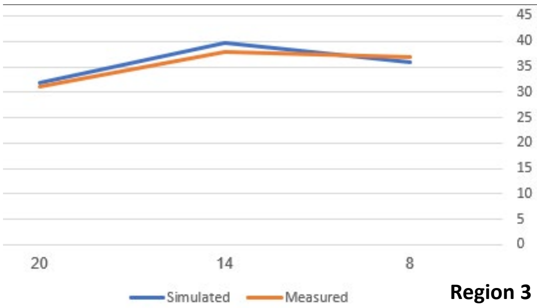
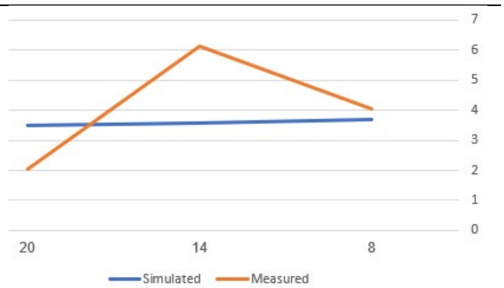
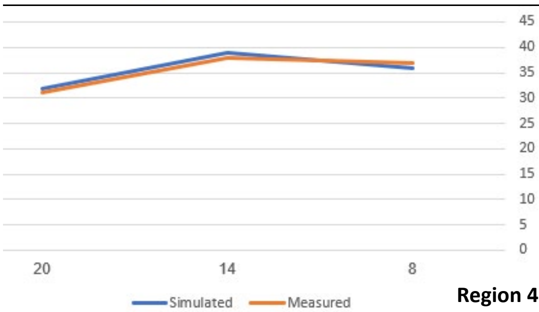
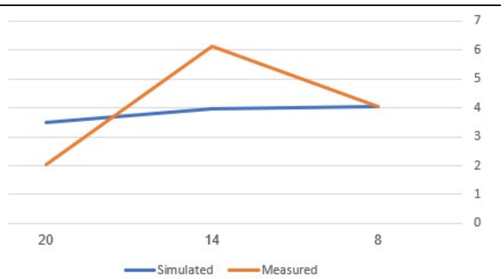
Temperature chart (X-Axis= Time and Y-Axis=° c)	Wind speed chart (X-Axis= Time and Y-Axis= m/s)
	
	
	
	

Table 3. Comparison of measured data with simulated data to check the validation of temperature and wind speed data in selected areas

carefully structured in a unique way, distinct for each type of model simulation. In n fact, QA remain the validation of the desired method in the operating system development phase, and QC is the validation in the software carrying out phase (Konieczka, 2007).

Table 3 shows that the simulation results in all four regions show a direct correlation with the measured results (meteorological station). Grounded on the results of this table, validation for the method has been done based on QA. Comparing the measured and simulated temperatures, the curves of both data are parabolic and indicate similar trends reflected in the peak and minimum values. The temperature changes in the simulated and measured data are extremely small. A comparison of wind speed at each site shows that simulated values did not vary significantly, but in most specific cases were close to measured values. The differences ranged from 4 to 20 effective percent, but the trends were consistent. The reasons for these differences are believed to be the limitations of the software simulation and measurement errors. The setting of the input conditions is also critically important. Since the initial wind speed and wind direction are from the meteorological station, which are different from the genuine values in the simulated environment, this is another reason for the observed difference between the simulated and measured data.

To quantitatively evaluate the accuracy of the local climate simulation with the ENVI-Met software and QC assessment for this software, the grid cell sizes in meters (dx, dy, dz) were changed in 5 simulations with values from 1 to 5 And for 8, 14 and 20 hours they were compared for the fourth region (Figure 1), because this area had more morphological elements (height of buildings, vegetation, and streets). Table 4 shows the scenarios of the sensitivity analysis and their values, as well as the simulation results of wind speed and ambient temperature in the direction of the QC review.

The smaller the grid cell size, the higher the simulation accuracy (Wang et al., 2019). Therefore, by comparing the scenarios with the values of 1 and 2 and taking into account that the maximum value of potential air temperature and the maximum value of wind speed in these two scenarios were close to each other, the value of the scenario dx=dy=dz=2 was chosen for running simulations and analyzing the results because the execution speed of the simulation

Table 4. quantitative test of the accuracy of the local climate simulation with ENVI-Met for region 4

Sensitivity analysis scenario	The value of the scenario	Time of day (hour)	The Maximum amount of temperature (°c)	The maximum amount of wind speed (m/s)
dx=dz=dy (m)	dx=dz=dy=1	8	36.45	5.02
		14	37.83	5.02
		20	31.60	4.64
	dx=dz=dy=2	8	35.86	4.06
		14	38.88	3.96
		20	31.92	3.84
	dx=dz=dy=3	8	36.32	3.63
		14	39.33	3.46
		20	32.31	3.48
	dx=dz=dy=4	8	36.45	3.68
		14	39.14	3.46
		20	32.39	3.48
	dx=dz=dy=5	8	36.58	3.43
		14	39.44	3.17
		20	32.55	3.18

in this scenario is higher than the value of the scenario dx=dy=dz=1. To quantitatively, test the accuracy of the simulation, measured data and simulated data were compared at 8:00, 14:00, and 20:00 for temperature and wind speed.

RESULTS AND DISCUSSION

Based on the above experimental evaluations, a numerical simulation was performed for the four regions indicated in Figure 4 to compare the results in terms of temperature and wind speed, and also to study the effects of wind speed on the reduction of potential air temperature in the Farahzad river valley area of Tehran.

These four areas are all located around the Farahzad river valley and were selected to typically allow a comprehensive study of the Farahzad river valley. The height of the buildings was determined by exploring the site and counting the floors of the buildings. The type of vegetation in the area was equally determined by field surveys. Table 5 describes the characteristics of these areas in detail.

The simulated results of temperature and wind speed at 8:00, 14:00 and 20:00 in these four regions were compared. The temperature in these regions starts increasing at 8:00, first in zone

Fig. 3. Satellite image and two-dimensional model for area number 4 (area selected for sensitivity analysis)

Fig. 4. Satellite images of the four selected areas to be entered into the Envi-met software (these images show the urban morphology factors studied in this research, i.e., trees, streets, and buildings, Source. Google Earth).

one and then in zone four, and then peaks at 14:00. In addition, the weather station outcomes show that the wind speed peaks at this hour, so the simulation results for 14:00 were compared. These consequences are shown in Figures 5 and 6.

The temperature and wind speed distribution diagrams are shown in Figures 7 and 8, respectively.

As mentioned in Table 5, there are good reasons for selecting the four study areas in the Farahzad river vallry. The results of the simulations show that the highest temperature was measured in area number 3 at 39.60 degrees Celsius. However, the air temperature in the river valley and around the vegetation was relatively low. On the other hand, the average temperature on the roads in areas 3 and 4 are higher than in the other two areas. In region No. 1, the starting point of the river valley, with low density and low buildings and relatively suitable vegetation, the air distribution in the river valley has developed well, so the maximum air temperature in this region is lower than in other regions (Wang et al., 2022). It is about 36.33 degrees Celsius. Due to the high vegetation cover and the average height of the buildings, there are more shaded regions in area 2. The air temperature in areas 1 and 2 are lower than in the other two areas. Due to the large topographical difference between these two areas of the river valley and the other two areas, which are at the same level as other urban areas, it was less affected by high temperatures on June 6, 2021, a hot day, which is aggravated in zone 1 due to the large distance

Table 5. Characteristics and reasons for the choice of the four selected areas

	Height of building(s) in meters	Types of trees	Topography (DEM) in meters	Reasons for choosing the region
Region1 	3	Plane Pine Walnut Apple	57	It is the starting point of the river valley.
Region 2 	3 4 6 8 9 10	Pine Acacia	57	It has significant vegetation.
Region 3 	3 6 14 21	Pine Plane	1	The relatively great height of the buildings and the difference in topography from the two previous areas
Region 4 	10 14 15	Pine Acacia Plane	1	This area is the end point of Farahzad River Valley.

between buildings and the height, because the wind flow is well distributed between buildings, but in zone 2, although the wind speed Is the highest and is about 6.12 meters per second, the air temperature has slightly increased compared to zone 1, which is due to the dense vegetation in this area and the small distance between buildings of medium height (Ma and Chen, 2022; Yuan et al., 2020). The temperature rises in zones 3 and 4. In region 3 the temperature is 39.60

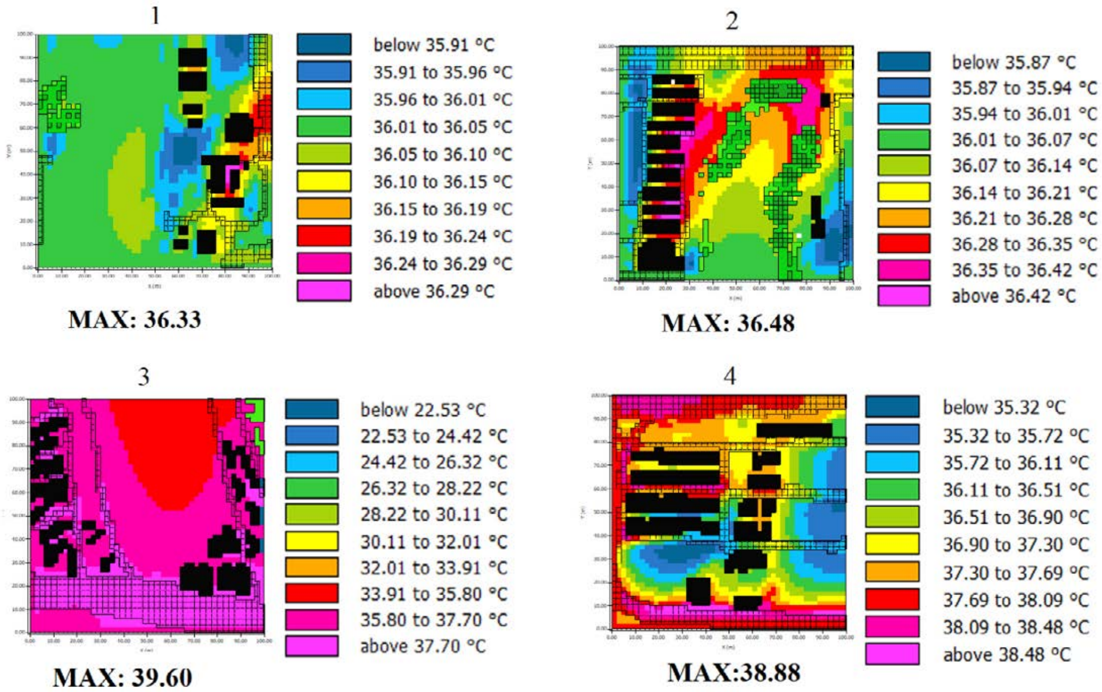


Fig. 5. Simulated temperature maps for the current situation in four selected regions

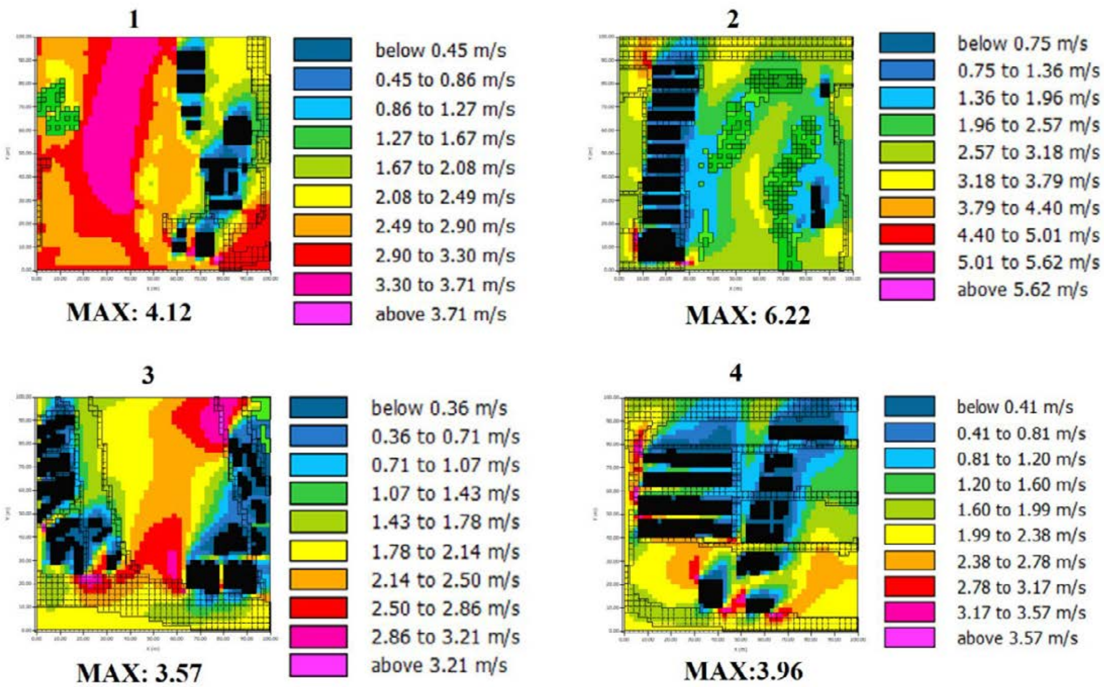


Fig. 6. Simulated wind speed maps for the current situation in four selected regions

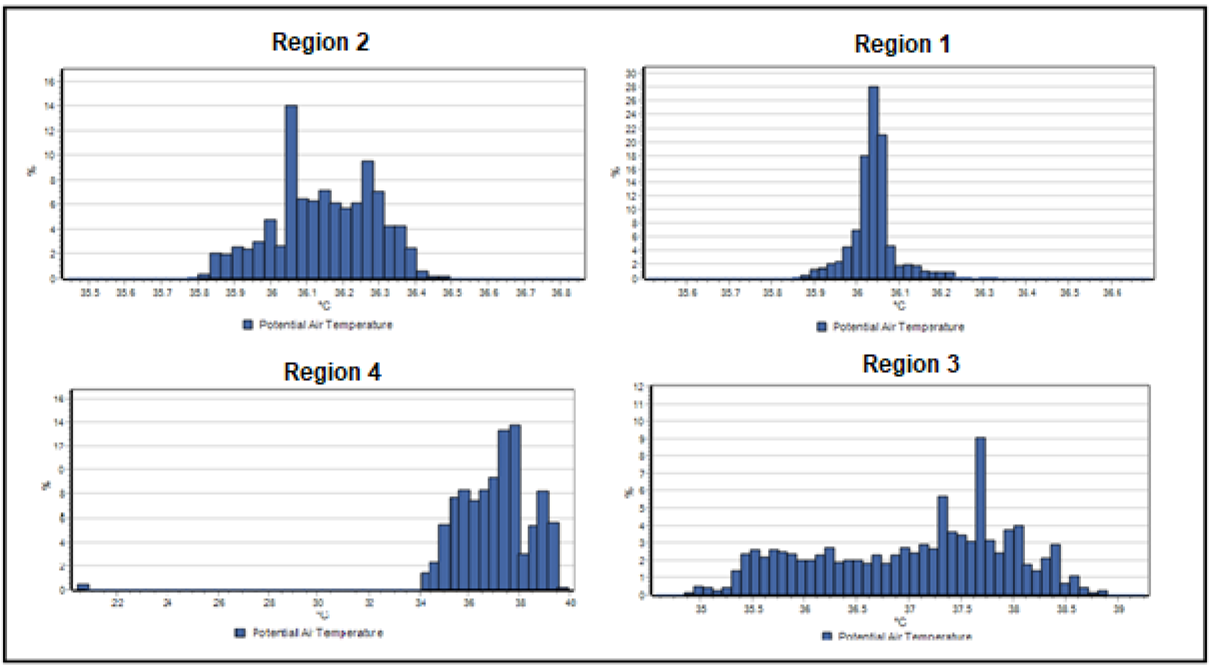


Fig. 7. Temperature distribution diagrams in the four studied areas for simulation day

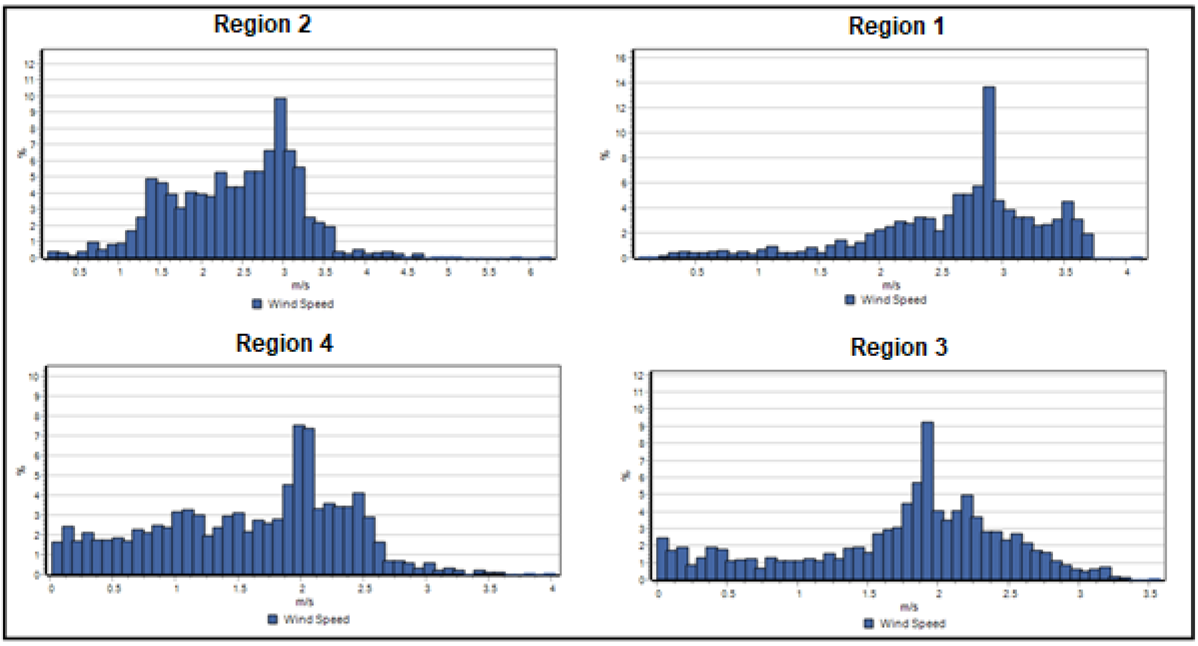


Fig. 8. Wind speed distribution diagrams in the four studied areas for simulation day

and in region 4 it is 38.88 because these regions are away from the wind flow corridor and this corridor is further blocked by Soleimani highway Then, at the end of the third area of Marzdaran Boulevard, it blocks the temperature and Due to the presence of tall buildings with small distances from each other, the wind is trapped at the base of the buildings and its speed becomes slower, therefore, despite the shading of the buildings in this area, due to the lack of suitable vegetation and the decrease in wind speed due to the change of direction by buildings, the temperature increases rapidly and reaches 39.60 degrees Celsius, while the wind speed is lower than in other regions and is about 3.57 degrees Celsius (Osinska and Zawalich, 2016). On the other hand, in region 4, the temperature is slightly lower, while the wind speed increases in this region and the vegetation in this region can reduce the temperature to a great extent. In addition, in all four regions, it can be seen that the temperature on the asphalt surface of the road increases because the asphalt has increased the impermeable surface of the soil, which reduces evaporation and transpiration and causes an increase in temperature (Sanagar Darbani et al., 2019; Emanuel and Loconsol, 2015). The graphs in Figures 3 and 4 also show that the temperature distribution in regions one, two, and three is uneven, although this inequality is more apparent in region one because the maximum temperature in this area is due to the asphalt surfaces of the roads. In the lower parts of the valley, the temperature distribution in the regions increases.

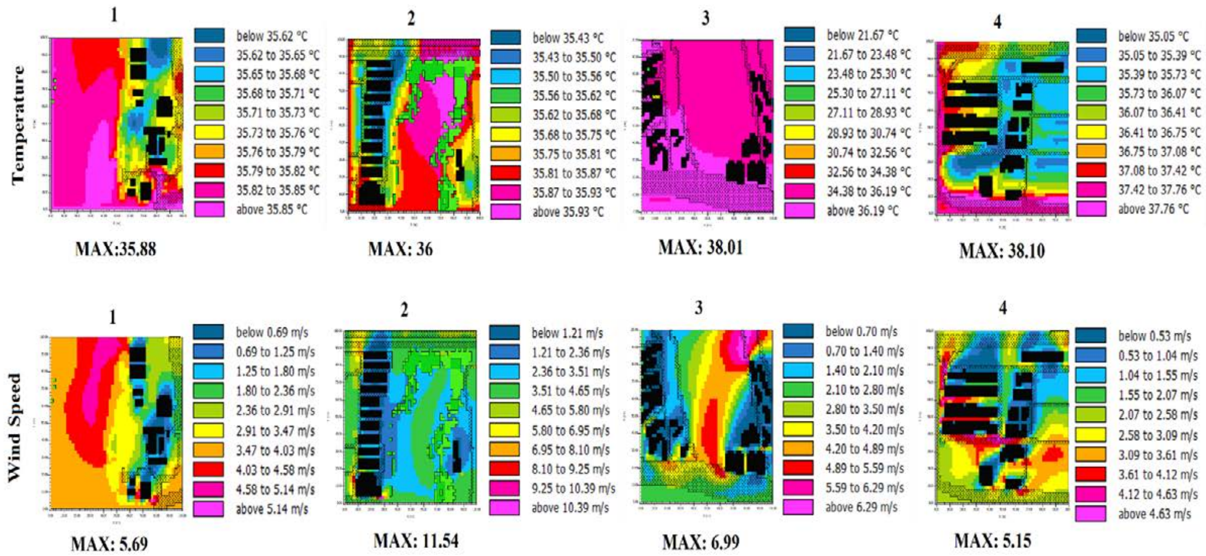


Fig. 9. Output maps of temperature and wind speed for the first scenario (in this scenario, the height of all buildings in the four selected areas was doubled)

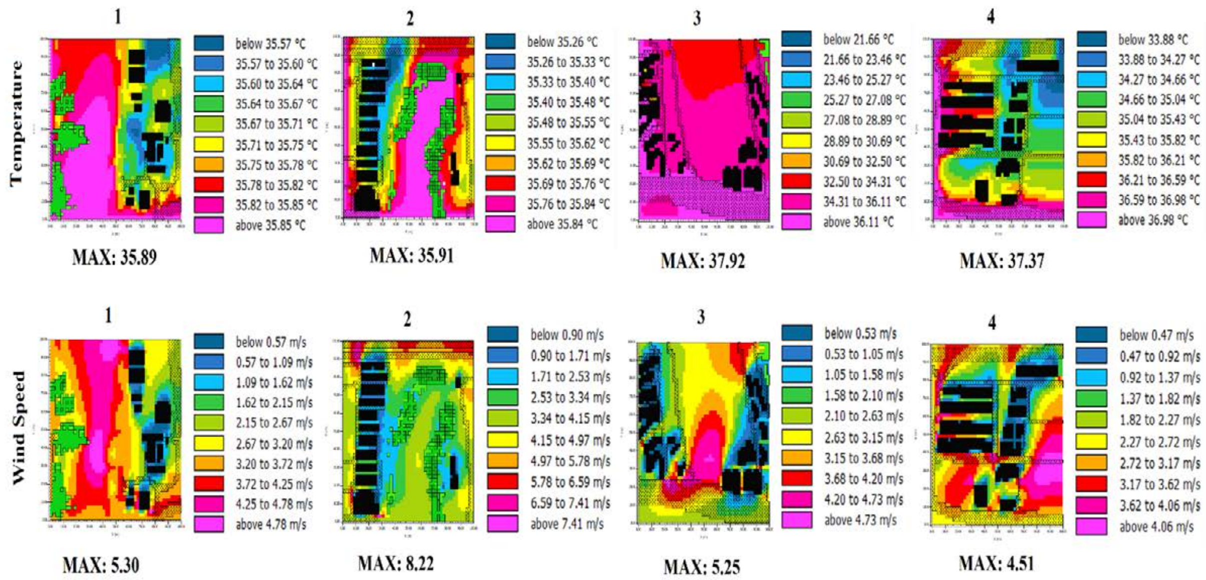


Fig. 10. Output maps of temperature and wind speed for the second scenario (in this scenario, tall trees are planted around the roads and highways of all selected areas at specific distances)

This may be due to the topography and the creation of an air corridor at the beginning of the valley, but the further down we go, the smaller the air corridor becomes (Alobeydi et al., 2016; He et al., 2019). This is because it is blocked by nearby highways and roads, and the temperature is distributed throughout the area. This is also seen in the wind speed, because the wind speed is highest in areas one and two, and as the maps also show, it increases within the valley, but the wind distribution is stronger in areas three and four. The comparison of the results of the current situation shows that the vegetation cover and the increase of shading in the areas around the Farahzad river valley have lowered the air temperature. Based on this, two scenarios were designed to study the morphological changes around this river valley (Ma and Chen, 2022). In the first scenario, the height of buildings was doubled, and in the second scenario, tall trees were planted at regular intervals around the streets. These scenarios are shown in Figures 9 and 10.

In the first scenario, doubling the building height increases the wind speed in the first zone by 1.57, in the second zone by 5.32, in the third zone by 3.42, and in the fourth zone by 1.19 m/s. In addition, the temperature in the first zone decreased by 0.45 degree, in the second zone by 0.48 degrees, in the third zone by 1.59 degrees, and in the fourth zone by 0.78 degrees. The rise in wind speed in regions two and three shows that the wind speed has increased due to the smaller distance between buildings and the more considerable height of buildings in these two zones. The temperature maps also show that the temperature has decreased in regions two and three due to the increase in wind speed. Although the wind speed has increased in region two, the reasonable distance between buildings results in less ventilation and the temperature is higher than in area two.

In the second scenario, by planting tall trees at certain distances around the streets, the wind speed in the first zone is 1.18, in the second zone is 2, in the third area in common is 1.68 and in the fourth zone is 0. 55 m/s have increased. In addition, the temperature in the first region has decreased by 0.44 degrees, in the second region by 0.57 degrees, in the third region by 1.68 degrees and in the fourth region by 1.51 degrees. Although the gradual increase in wind speed was higher in regions one and two, the temperature decreased less in these two regions. The temperature maps also show that it declined in the third and fourth regions due to the increase in temperature.

Four areas in the Farahzad river valley were selected for this article, two of which are about 55 meters above the ground and the other two at the same level as other areas of the city. These areas were then simulated in the ENVI-met software using input data point from the Mehrabad meteorological station and additional data mentioned in the article since June 6, 2021. The results of the existing situation show that the creation of shaded regions lowers the temperature. Based on these consequences, increasing tall buildings and planting tall trees can also gain wind speed. On the other hand, the study and comparison of the results of these four areas showed that in regions three and four, due to the more considerable number of streets, the impermeable soil layer increased and the temperature increased. On this basis, the above scenarios were designed. From the results of the scenarios, it appears that increasing the height of the buildings increases the wind speed; however, it does not affect the temperature reduction as much as planting tall trees along the streets. The correctness of this fact can be confirmed by checking the temperatures of the third and fourth regions as the regions with more excessive temperatures.

CONCLUTION

With increasing urbanization, river valleys, which are natural corridors in urban areas, have been neglected and over time have lost their effectiveness as climate control systems due to inappropriate urban design elements. For this reason, it is important to use these natural corridors to improve the quality of urban space in large cities like Tehran, as temperatures are unbearable during the hot seasons. The results of the article suggest there is a close relationship between urban valleys and wind flow and the reduction of temperature in the city. According to the consequences, the hottest areas are streets and highways, and this heat increases with the expansion of urban areas and the growth in building density, as well as the closure of river valleys. The results of the article show that increasing vegetation and planting tall trees around the streets of river valleys lower asphalt temperatures and improve climate control for the inhabitants of these regions. Based on these results, the following solutions are proposed:

- Placing plants with low leaf area density and appropriately spaced from each other (not densely) in the direction of local winds of the region, especially on elevated highways built against the direction of the Farahzad corridor.
- Construction of urban elements to change the direction of the wind and rise the wind speed at a distance between buildings especially tall buildings
- The use of building materials with high permeability around the river valley and green areas between buildings as ground cover to increase transpiration and potential evaporation of plants and cool the environment
- The extensive use of urban elements in the highways around the region to divert the wind flow caused by the Farahzad corridor and addition the wind speed to cool the environment
- Sufficiently develop plans to progressively reduce specific fuel consumption to lower temperatures and increase the use of wind energy as an renewable energy source to increase urban sustainability in such local areas.

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CONFLICT OF INTEREST

The authors declare that there is not any conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

LIFE SCIENCE REPORTING

No life science threat was practiced in this research.

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