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Retraction

Retracted: Energy Conservation Optimization and Numerical Simulation of Urban Green Space Landscape Pattern

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] L. Wang, "Energy Conservation Optimization and Numerical Simulation of Urban Green Space Landscape Pattern," *International Transactions on Electrical Energy Systems*, vol. 2022, Article ID 5324854, 7 pages, 2022.

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Research Article

Energy Conservation Optimization and Numerical Simulation of Urban Green Space Landscape Pattern

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In order to alleviate the urban heat island effect, absorb harmful gases, reduce temperature, and increase humidity, a method of energy conservation optimization and numerical simulation of urban green space landscape pattern is proposed. Based on the theory of landscape ecology, green wedge, green belt, green road, park, and other types of green space with different ecological functions are designed in Shenyang, and an optimization scheme of urban green space network spatial structure of "four belts, three rings, seven wedges, and network connection" is formed. Combined with remote sensing (RS) and geographic information system (GIS) spatial analysis technology, the atmospheric environment effect under the influence of green space landscape optimization pattern in summer based on computational fluid dynamics (CFD) numerical simulation technology is analyzed, and the corresponding optimization strategies of urban green space planning are put forward. The simulation results show that in the bottom wind speed field of 1.5 m, the area ratio of 0~0.375 m/s wind speed is 15.87%, and the area ratio of 2.625~3 m/s wind speed is 32.06%. In the bottom concentration field of 1.5 m, the spatial diffusion capacity of SO_2 pollutants is enhanced, and the concentration of pollutants is relatively low. The area ratio of SO_2 concentration is 10.06% in the range of 0.1292~0.1551 mg/m^3, and the area ratio of SO_2 concentration is 68.08% in the range of 0~0.05169 mg/m^3. It is concluded that the spatial diffusion of wind speed, SO_2, and temperature is closely related to the urban spatial layout. The optimal spatial layout of urban green space can effectively alleviate the urban heat island effect, promote the spatial diffusion of SO_2, and better form the urban ventilation corridor. The research on atmospheric environmental effects of urban green space based on CFD can effectively simulate and evaluate the optimization measures and conceptual design of urban green space system planning, and also provide new ideas for the quantitative planning of urban green space system.

1. Introduction

City is the main place for human settlement and living; that is, human beings make use of and transform the natural environment according to their living needs to form a high-level artificial living environment. As the urban population density increases year by year and the available land decreases year by year, the city is facing a huge crisis and its sustainable development is seriously threatened. The harmonious coexistence of human beings and environment has become a hot issue. Urban ecologist Richard Regist once compared a city to a ship. He said, "A city is like a ship setting out on the future journey of mankind. The better its structure and function are, the more normal the sailing will be." Urban ecosystem is highly dependent on the external environment [1].

Green space (Figure 1), representing nature and life, is called "lung of the city." The concept of green space in Ci Hai refers to the selection of trees, shrubs, and herbs suitable for planting on the basis of the existing environment, so as to form a certain range of green areas. Urban green space is the area in which the natural landscape is maintained or restored in the city, which comprehensively reflects the natural landscape and cultural landscape in the city. With the acceleration of urbanization and the continuous deterioration of urban environment, people no longer pay attention to the aesthetic effect of green space, but also begin to pay attention to its structure and function [2, 3]. If the urban green space

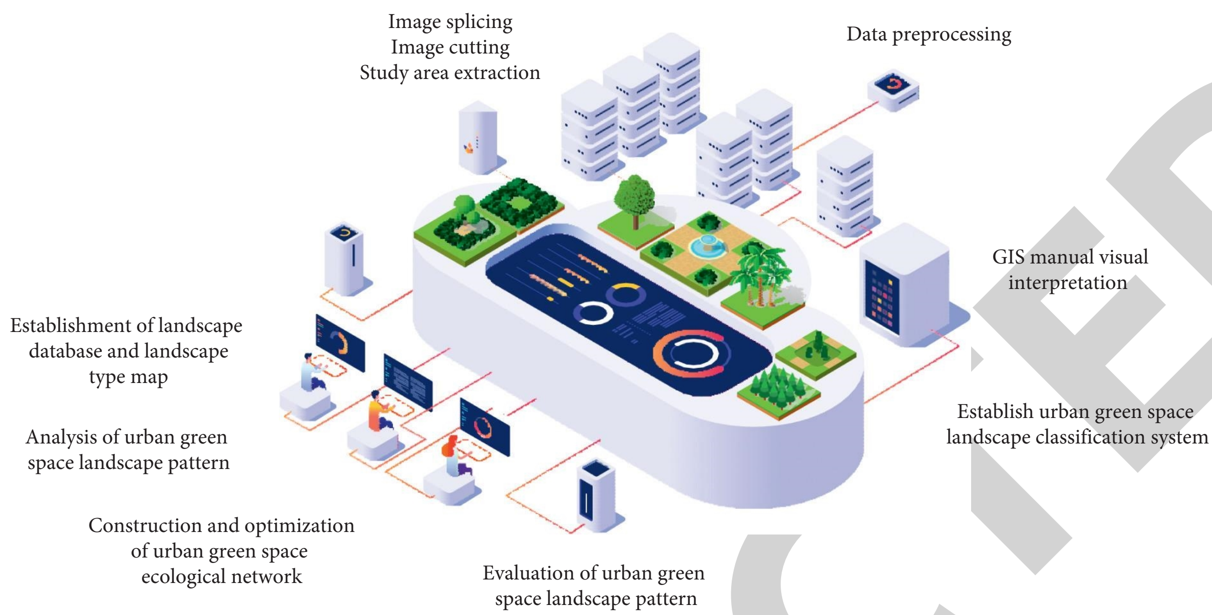

Figure 1: Green landscape.

cannot form a reasonable green space system structure, it is difficult to give full play to its ecological value. In order to realize the sustainable development of urban and improve the increasingly prominent urban ecological problems, the integration of multidisciplinary and multifield theories should be realized, and new planning concepts and technical means should be adopted to explore the reasonable content and layout of urban green space in the rigidly constrained urban space, so as to effectively utilize the ecological function of green space and realize the sustainable development of the city.

2. Literature Review

Liu et al. planned and studied a wide range of open space by applying the principles of landscape ecology and combining landscape structure and landscape function. Moreover, foreign research studies on the construction of urban green space system from the perspective of landscape ecology mostly focused on the ecological network, greenway, and green line, and regarded them as new planning parameters of man and nature [4]. Hou et al. mainly studied the ecological and social role of "green line" in urban landscape [5]. Su and Yu put forward some suggestions on the development of green space system in New York from the aspects of ecological principles such as ecological content, dynamic mechanism, heterogeneity, and hierarchy [6]. Ji et al. proposed a universal model for applying ecological knowledge to landscape and the urban planning [7].

Since the 1990s, people have paid more and more attention to the role of urban green space system in urban sustainable development strategy and urban biodiversity protection. Luo et al. proposed the theory and method of landscape ecological pattern internationally for the first time, and applied it to urban green space planning [8]. Miszczak et al. first discussed the reasonable basis for the existence of artificial corridors and natural corridors in urban landscape based on the corridor effect theory, and proposed the alternate distribution of artificial and natural corridors in Beijing to form an organic dispersed landscape pattern [9]. Wang et al. also proposed the urban spatial layout with green veins as the precursor [10]. Zuo et al. discussed the relationship between landscape ecology and urban landscaping, expounded the concentric circle model of urban spatial structure and the planning and design principles of green space landscape ecology, and proposed the methods, approaches, and quantitative measurement indexes of planning and design combined with its principles [11].

Taking the urban area within the third ring road of a city in summer as the research object, in the urban scale, RS, GIS spatial analysis technology, and CFD numerical simulation technology were used to comprehensively analyze the urban atmospheric environmental effects under the influence of the urban green space landscape pattern optimization scheme. The interaction between the planning scheme and wind speed, temperature, and SO_2 concentration was explored, the urban green space layout and functional division were determined and guided according to the evaluation results, and the rationality of the green space layout of the scheme was evaluated. In the planning, the optimization measures and conceptual design of urban green space system planning can be simulated and evaluated, so as to provide a certain reference for the optimization of urban green space landscape pattern [12].

3. Research Methods

In the urban green space system planning, first of all, according to the related theory of landscape ecology, qualitative and quantitative methods are used to optimize the urban green space planning design. Secondly, combining the RS, GIS, and CFD simulation technology for the urban atmospheric environment under the influence of the green space optimization effect, the numerical simulation analysis is performed in the evaluation of the rationality of the green space optimization scheme. Finally, corresponding planning strategies are proposed according to the evaluation results, so as to form a multiobjective, multilevel, and comprehensive ecological network structure of urban green space [13].

3.1. The Optimization Design of Urban Green Space Landscape. In order to exert the ecological function of urban green space ecological network structure efficiently, a green space network spatial structure of "four belts, three rings, seven wedges and network connection" is formed by combining centralized and decentralized layout mode.

At the municipal level, five green wedges of "ventilation corridors" are established in a certain city. Under the guidance of the dominant urban wind, the lower temperature air in the suburbs can be introduced into the urban interior with high-building density, so as to reduce the poor thermal environment in a city in summer and strengthen the connection between the surrounding area and the urban area. Two ecological green wedges can be established in the north and northeast of the site in order to connect with the surrounding mountains and farmland, so as to achieve the purpose of "introducing nature into the city."

On the urban scale, the green space vegetation area should be increased in the low-lying area of the urban high-building density area, and the urban ventilation corridor should be formed. Urban ventilation corridors shall be established in or along urban roads in areas where urban wind speed is not impeded. Relatively large green spaces should be established near new buildings. The construction of green belt around the city should be carried out around three main ring roads, and the construction of green belt around the city water system should be strengthened to improve the quality of urban air environment [14]. At the neighborhood scale, the greening structure is optimized according to the local spatial pollution of the city [15].

3.2. Simulation of Urban Atmospheric Environmental Effects Based on Remote Sensing and CFD

3.2.1. Establishment of Urban Digital Module. In the numerical simulation, considering the urban wind speed, temperature, humidity, solar radiation, and other meteorological parameters, the spatial layout of various landscape elements in the city, building density, floor area ratio, population density, vegetation coverage and topographic characteristics, and other factors will have different impacts on the urban atmospheric environment effect. Therefore, It is necessary to establish an accurate and reasonable CFD urban digital model [16]. In the process of city classification, city classification is carried out based on the spatial information of underlying surface and comprehensive consideration of building density, vegetation coverage degree, floor area ratio, surface temperature, SO_2 pollution degree, and population density in the region.

3.2.2. Setting of CFD Simulation Parameters. Calculation of watershed is determined. In CFD simulation, a zoom of urban space is first created, and the length, width, and height of zoom in CFD are determined, which should generally be appropriately larger than the whole city model for CFD simulation environment simulation. In the research, a 1 : 1 model was used to conduct research, and the zoom scale of the digital model of a city was 50,000 m × 50,000 m × 200 m.

Setting of initial conditions is as follows. After establishing the model in CFD, it is necessary to input the basic information data of a city as the initial conditions of simulation, such as latitude and longitude, calculation time, and parameters related to solar radiation. The air inlet and air outlet are established at the corresponding position of the geometric model. Under the influence of the south wind, the dominant wind direction in a city in summer, the average wind speed of the city is 3 m/s, and the average daily temperature is 29°C [17]. According to the analysis and conversion of relevant climate data, the relevant parameters of wind speed and temperature in CFD, as well as the initial parameters of air inlet and air outlet in the simulation boundary, are set to accurately simulate the climate environment of the urban digital model in CFD. The initial temperature and pollution source concentration of different modules are set according to the surface temperature and emission concentration of main pollution sources obtained from the field monitoring, remote sensing analysis, and GIS interpolation analysis.

3.2.3. The Calculation Process of CFD Model. After the parameters are set, the model can be calculated. It will simulate the spatial operation of urban wind speed, SO_2, temperature, and other atmospheric environmental factors under the spatial layout of urban green space.

(1) Grid Division. For the research of urban scale, appropriate grid accuracy should be selected according to the spatial form and structural composition of urban modules, and local grid encryption should be carried out in areas with relatively complex module structure. The finer the grid division, the higher the calculation accuracy [18].

(2) Calculation Principle. The basic formulas of the noncompressible and nonisothermal flow field simulated by the CFD model are shown in the following formulas:

$$\frac{\partial (u_i)}{\partial x_i} = 0, \tag{1}$$

$$\frac{\mathrm{d}u}{\mathrm{d}t} = -\frac{1}{\rho}\frac{\partial P}{\partial x_j} + \frac{\partial\left(\nu\left(\partial (u_i)/\partial x_j\right)\right)}{\partial x_j} - g\beta\Delta\theta, \tag{2}$$

$$\frac{\mathrm{d}\theta}{\mathrm{d}t} = \frac{\partial\left(\alpha\left(\partial\theta/\partial x_i\right)\right)}{\partial x_j}, \tag{3}$$

$$\frac{\partial (C_i)}{\partial t} + \frac{\partial (u_i)(C_i)}{\partial x_i} = \frac{\partial}{\partial x_i}\left(D\frac{\partial (C_i)}{\partial x_i} - (u_i C_i)\right). \tag{4}$$

where u_i is the instantaneous velocity (m/s); x_i, the space coordinate (m); t, the time (s); ρ, the density (kg/m^3); P, the instantaneous pressure (N/m^2); ν, the molecular kinematic viscosity (m^2/s); g, the acceleration of gravity (m/s^2); β, the volume expansion coefficient (°C^{-1}); θ, the instantaneous temperature (°C); θ_0, the temperature (°C); and α, the molecular thermal diffusion coefficient (m^2/s).

(3) Convergence. In numerical simulation analysis, the basic formulas need to be repeatedly calculated, and the operation can be completed only when the operation factor tends to be stable or the calculation structure reaches a certain range, which is called convergence. If the convergence effect is not ideal, the model parameters need to be adjusted for the convergence problem.

(4) Analysis of Calculation Results. When the calculated results reach the ideal state, the results can be displayed in terms of wind speed, SO_2, temperature, and other factors. The horizontal and vertical direction of the numerical display chart can be chosen, and it reflects the atmospheric environment of the city generally according to the numerical results in accordance with different colors.

4. Result Analysis

With the increase in urban height, urban building density and floor area ratio decrease continuously, and the resistance of urban wind speed, temperature, and SO_2 spatial diffusion decrease, and the resistance of spatial diffusion is inversely proportional to the diffusion height. In different height ranges of 0~200 m, the height range of 0~10 m (including 10 m) is defined as the bottom effect field, the height range of 10~50 m (including 50 m) is defined as the middle effect field, and the height range of 50~200 m is defined as the top effect field [19].

4.1. Simulation Analysis of Urban Wind Speed Field at Different Heights. From the diffusion analysis of urban wind speed at different vertical heights, it can be seen that the urban wind speed tends to increase with the increase in height, and the area covered by the maximum wind speed in the city keeps increasing. But the trend of the spatial diffusion range gradually increases is not obvious, and the ventilation condition of the city is relatively good. In the bottom wind speed field of 1.5 m, the area ratio of 0~0.375 m/s wind speed in urban inner space is 15.87% and that of 2.625~3 m/s wind speed is 32.06%. Areas with high wind speed in the city are still mainly distributed in some areas on the windward side. It will be conducive to urban spatial diffusion of pollutants in the air. At the same time, the urban ventilation corridors in the southwest and southeast directions are formed in the whole city, while under the influence of building density urban ventilation corridor's sphere of influence with attenuation effect, but it is important for the spread of the urban air pollutants and the high-temperature area [1].

In the bottom wind speed field of 10 m, the buildings have a great influence on the urban wind speed. Compared with the bottom wind speed field of 1.5 m, the wind speed between 2.625 m/s and 3 m/s has a great improvement, and the area ratio increases from 32.06% to 56.64%. In the middle wind speed field (30 m, 50 m), the maximum wind speed of the city also increases, and the area ratio increases from 56.64% to 77.72%. In the top wind speed field of 100 m, the area ratio of the maximum wind speed of the city increases to 79.71%.

4.2. Simulation Analysis of Spatial Diffusion of SO_2 Concentration Field at Different Heights. From the diffusion analysis of urban SO_2 concentration at different vertical heights, it can be seen that with the continuous increase of urban height, the concentration of SO_2 gradually decreases with the increase in height. At the same time, under the influence of urban wind speed, the spatial diffusion capacity of SO_2 is significantly enhanced, and the urban air pollution environment has been further improved. In the bottom concentration field of 1.5 m, the spatial diffusion ability of SO_2 pollutants is enhanced, and the concentration of pollutants is relatively low. The area ratio of SO_2 concentration value of 0.1292~0.1551 mg/m^3 is 10.06%; the SO_2 concentration value is mostly concentrated in the concentration range of 0~0.05169 mg/m^3; and the area ratio is 68.08%.

With the increase in height, the area ratio of concentration values below 0.051 69 mg/m^3 reaches 60.07% in the bottom concentration field of 10 m, 69.13% in the middle concentration field of 50 m, and 75.4% in the top concentration field of 100 m. In the bottom concentration field of 1.5 m, the maximum concentration value is 0.1551~0.1809 mg/m^3, and the area ratio is 5.36%. In the middle concentration field of 50 m, the maximum concentration value is 0.1292~0.1551 mg/m^3, and the area ratio is 7.3%. In the top concentration field of 100 m, the maximum concentration value is 0.1034~0.1292 mg/m^3, and the area ratio is 6.4%. From the perspective of the whole city, under the guidance of urban wind environment, pollutants can effectively diffuse to the periphery of the city, and the spatial layout of urban green space can promote the diffusion of air pollutants to a certain extent, and the air environmental quality of the whole city has been improved to a certain extent [20].

4.3. Simulation Analysis of Spatial Diffusion of Urban Temperature Field at Different Heights. From the diffusion analysis of urban temperature field at different vertical heights, it can be seen that with the increase in height, temperature presents a trend of gradual decrease, and its diffusion ability gradually increases with the increase in urban wind speed. In the bottom temperature field of 1.5 m, the high-temperature area of a city can well spread to the outer part of the city under the influence of urban wind speed, and the high-temperature phenomenon will not have a great influence on the city. In other areas of the city, the urban high-temperature phenomenon is not obvious, and the heat island effect in the central urban area is effectively alleviated. In the whole city, urban green space, Hun River, and surrounding green space and other water bodies have an obvious effect on urban temperature regulation, which is of great significance to alleviate the urban heat island effect. In the bottom temperature field of 1.5 m, the highest temperature is between 42.75°C and 46°C, and the area ratio is 0.56%. In the middle-temperature field of 50 m, the highest temperature of urban temperature is mainly concentrated between 39.5°C and 42.75°C, and the area ratio reaches 4.72%. In the top temperature field of 100 m, the urban temperature is mainly concentrated between 39.5°C and 42.75°C, and the area ratio is only 2.07%. In the bottom temperature field of 1.5 m, the lowest temperature is between 29.75°C and 33°C with an area ratio of 7%. In the middle-temperature field of 50 m, the lowest temperature is between 26.5°C and 29.75°C with an area ratio of 0.95%. In the top temperature field of 100 m, the lowest temperature is between 26.5°C and 29.75°C. The area ratio is 1.01%. Therefore, although the area ratio of the minimum temperature increases with the increase of the height of the city and the temperature of the whole city gradually decreases in the scheme, the operation of the urban thermal environment is relatively good.

4.4. Verification of CFD Simulation Results. The accuracy of the CFD numerical simulation results is verified by domestic and foreign scholars. In the research, the validation data are mainly used in a variety of monitoring data. The data verification points are mainly distributed in city residential area, within the scope of the third industrial park, park green space, and commercial and culture area. And 30 monitoring stations are selected to validate the results of model simulation. The results show that the relative errors between the simulated wind speed, SO_2 concentration, and temperature and the measured values are small, which meet the accuracy of urban scale numerical simulation (Figures 2~6). Therefore, CFD is feasible to simulate the effect of the atmospheric environment.

4.5. Optimization Strategies of Urban Green Space Landscape Planning. Based on the CFD simulation analysis of the atmospheric environment effect of urban green space optimization scheme, it can be seen that there is a one-to-one correspondence between the urban ventilation corridor area in the optimization scheme and the urban ventilation area in the CFD numerical simulation analysis, indicating that the ventilation corridor in the optimization scheme is reasonable, which can blow the low-temperature air in the suburbs into the high-temperature area inside the city, and can effectively alleviate the urban heat island effect. Under the influence of the dominant wind direction of the city, the area with high concentration of SO_2 continuously diffuses to the periphery, and the concentration gradually decreases. With the increase in height, the maximum concentration value also decreases accordingly. The optimization scheme of urban green space system plays an obvious role in improving

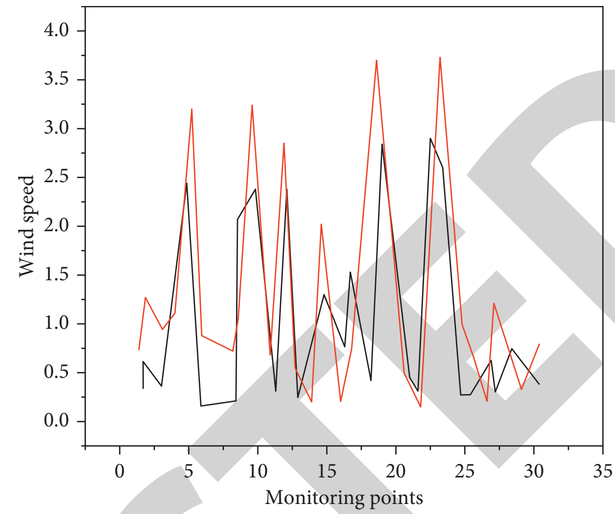

Figure 2: Simulation wind speed.

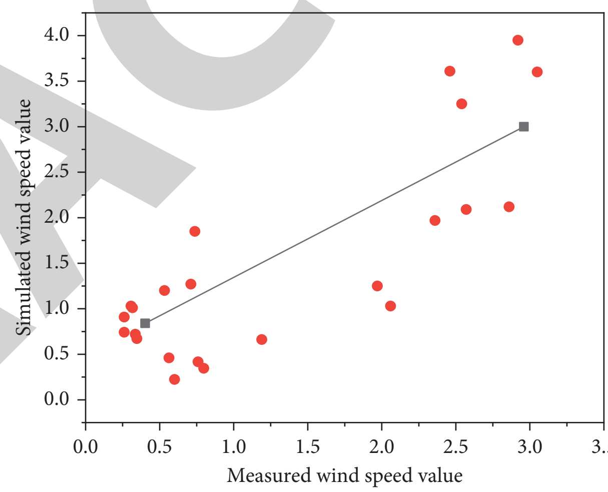

Figure 3: Measured wind speed.

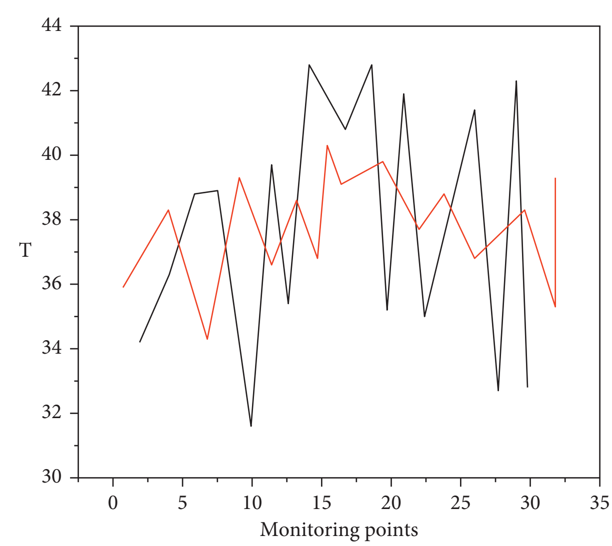

Figure 4: Simulated SO_2 concentration monitoring.

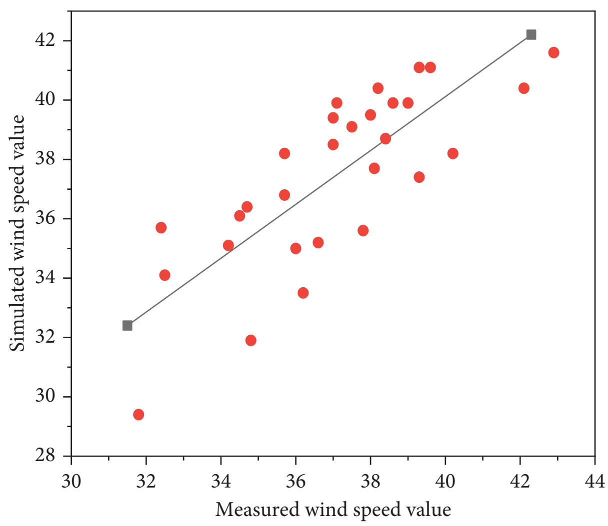

Figure 5: Measured SO2 concentration.

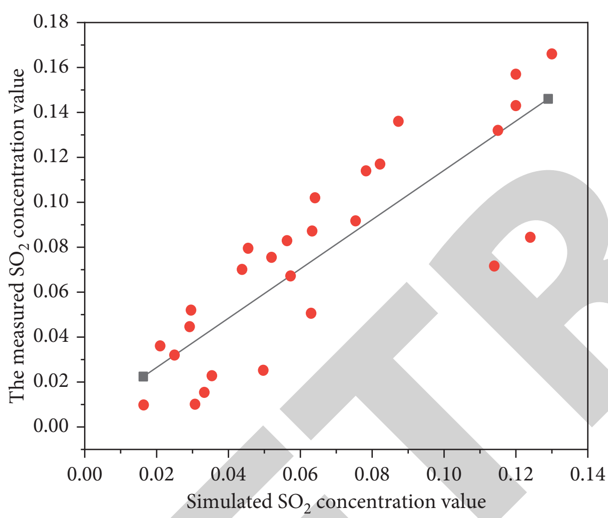

Figure 6: Comparison trend between simulated and measured temperature values.

urban atmospheric environment, and the scheme has certain rationality. Therefore, in green space system planning, according to the numerical simulation analysis results of green space optimization scheme, corresponding quantitative analysis methods can be used to adjust the optimization scheme at different scales and a systematic ecological network of urban green space is formed, so as to give full play to the maximum ecological efficiency of green space.

5. Conclusions

Based on the principles of landscape ecology and green space layout method, the urban green space network spatial structure optimization scheme is put forward. By using the CFD model, the simulation analysis is carried out on the optimization of atmospheric environment effects, and the rationality of its spatial layout is evaluated. At the same time, based on the simulation analysis results, the corresponding strategy of urban green space system planning is put forward. The results show that the optimization scheme of green space in a city has a good effect on the formation of urban ventilation corridors and promoting the diffusion of SO_2 pollutants. Although there are many high-temperature areas in the diffusion of urban temperature field, the spatial diffusion capacity of the optimization scheme is relatively strong. Considering the urban wind environment, thermal environment, and the spatial diffusion capacity of SO_2 air pollutants, the layout of urban green space under the optimization scheme is relatively reasonable. Therefore, in the spatial layout planning of urban green space, the spatial layout of urban green space can be optimized at the scale of urban area, city, and block neighborhood from a systematic perspective. At the municipal scale, RS, GIS, CFD numerical simulation technology, green ecological infrastructure construction and evaluation system, and other methods are coupled to identify ecological factors, historical factors, cultural factors, and recreational factors that affect the quality of urban air environment so as to jointly build a multiobjective and comprehensive urban green space ecological network. At the urban scale, numerical simulation and other techniques are used to identify potential ventilation corridors, green belts, and other landscape elements in different functional areas, so as to alleviate urban atmospheric environment problems by forming urban ecological protection green network. At the neighborhood scale, the scale, location, form, spatial structure, and vegetation composition of green space should be reasonably planned, and the rational spatial structure layout of green space should be found by combining multiscenario plan simulation analysis to guide the spatial diffusion of pollutants and slow down the urban heat island effect, so as to improve the quality of urban environment.

Data Availability

The data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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