

## ASSESSMENT OF URBAN HEAT ISLANDS IN TASHKENT CITY BASED ON REMOTE SENSING DATA

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**Annotation.** *This article examines the urban heat island phenomenon in Tashkent city based on Masofaviy zondlash data. During the study, land surface temperature (LST) was determined using satellite imagery, and the spatial distribution of heat islands was analyzed. The main factors influencing their formation, including the reduction of green areas, increased building density, and growth in the number of vehicles, were scientifically substantiated. The results show that in certain areas of Tashkent city, the intensity of heat islands is high, which negatively affects the ecological environment. Practical recommendations for mitigating this phenomenon are also proposed in the article.*

**Keywords:** *Urban heat islands, remote sensing, urbanization, ecology, GIS, urban climate, thermal analysis, green areas.*

### **Introduction**

Currently, due to the rapid development of urbanization processes and global climate change worldwide, various environmental problems are emerging in urban environments. One of the most significant among them is the Urban Heat Island (UHI) phenomenon, which has gained considerable scientific and practical importance.

This phenomenon is characterized by higher air and land surface temperatures in urban areas compared to surrounding natural regions. The main causes include the expansion of artificial surfaces (asphalt, concrete), reduction of green areas, increased number of vehicles, and anthropogenic heat emissions.

The urban heat island effect significantly impacts not only the urban microclimate but also human health, energy consumption, and overall environmental sustainability. Particularly during summer, this phenomenon intensifies, leading to heat stress, increased air pollution, and deterioration of living conditions. Therefore, studying and assessing this issue on a scientific basis has become one of the important directions of modern research.

Nowadays, the development of Masofaviy zondlash technologies allows the assessment of the thermal condition of urban areas remotely. Using satellite imagery, it is possible to determine land surface temperature (LST), analyze land cover types, and monitor their changes.

This enables the identification of the spatial distribution and intensity of heat islands, as well as the determination of key influencing factors. Tashkent, as one of the major and rapidly developing cities in Central Asia, has been experiencing intensive construction and urbanization in recent years. As a result, natural landscapes are decreasing while artificial infrastructure is expanding.

This creates favorable conditions for the formation of urban heat islands. Therefore, studying heat islands in Tashkent using remote sensing data is a relevant scientific and practical issue.

### **Relevance**

At present, global climate change and rapid urbanization are intensifying environmental problems in urban areas. In particular, the strengthening of the urban heat island effect leads to increased temperatures, higher levels of air pollution, and negative impacts on human health. The reduction of green spaces, expansion of concrete and asphalt surfaces, and the increase in the number of vehicles further accelerate this process.

Modern Masofaviy zondlash technologies make it possible to detect and evaluate urban heat islands efficiently, providing fast, accurate, and large-scale data. Studying this issue in the context of Tashkent is of great scientific and practical importance for improving the urban ecological environment and ensuring sustainable development.

### **Objective**

The main objective of this study is to identify urban heat islands in Tashkent city using Masofaviy zondlash data, to assess their spatial distribution, and to scientifically analyze the main factors influencing this phenomenon.

### **Main Part**

The Urban Heat Island (UHI) phenomenon is one of the key concepts in modern urban ecology. It is characterized by higher air and land surface temperatures in urban areas compared to surrounding rural or natural regions. In scientific literature, this process is explained as a microclimatic change caused by anthropogenic activities. The main factors include the replacement of natural landscapes with artificial surfaces, increased building density, the abundance of heat-absorbing materials, and additional heat generated from energy consumption.

The urban heat island effect is also associated with changes in the radiative balance, as urban surfaces with low albedo absorb more solar radiation. As a result, the difference between daytime and nighttime temperatures decreases, and heat is retained for longer periods. This phenomenon is closely linked to global climate change and is especially pronounced in large cities. Scientific studies indicate that urban heat islands cause not only environmental but also socio-economic problems.

Furthermore, urban heat islands influence atmospheric circulation processes, wind speed, and humidity levels, leading to the formation of unfavorable microclimatic conditions in urban areas. Therefore, a comprehensive theoretical understanding of this phenomenon is essential for developing effective prevention and management strategies.

The formation of urban heat islands in cities is influenced by a combination of natural and anthropogenic factors. One of the primary factors is the change in land cover. The replacement of natural soil and vegetation with asphalt, concrete, and other artificial materials increases heat absorption and re-emission, leading to higher temperatures.

The reduction of green areas is another significant factor. Vegetation cools the environment through transpiration, but its decline reduces this natural cooling mechanism. In addition, the increasing number of vehicles and industrial facilities in urban areas contributes to additional heat emissions, further raising overall temperatures.

Building density also plays a crucial role. High-rise and densely packed buildings reduce the reflection of solar radiation and trap heat. Air circulation is restricted, slowing down the cooling process. The lack of water bodies also contributes to increased urban temperatures.

All these factors interact collectively, leading to the formation and persistence of urban heat islands in city environments.

Remote sensing technologies are an integral part of modern geoinformation research. This technology allows obtaining information about the earth's surface using satellites and other remote devices. Especially in the study of heat islands in urban environments, this method provides high accuracy and comprehensive analysis capabilities. One of the main advantages of remote sensing is the ability to cover large areas in a short time. This is much more effective than traditional field studies. Satellite images can determine many indicators, such as land surface temperature, vegetation cover, and humidity. This technology also allows you to track changes over time. This is important in analyzing the dynamics of heat islands.

Remote sensing data provides more effective results when integrated with geographic information systems (GIS). This technology is widely used in scientific research, urban planning, and environmental monitoring. It is one of the most modern and reliable methods for identifying and assessing heat islands.

Land Surface Temperature (LST) is one of the main indicators for determining and assessing heat islands. LST is mainly determined using data from satellites in the thermal infrared range. This data records the heat radiation emitted by the earth's surface and allows it to be converted into temperature values. The process of calculating LST consists of several stages, first, digital values are obtained from satellite images. Then, these values are converted into physical quantities through radiation calibration. After that, the brightness temperature is determined and the actual LST values are obtained by taking into account the emissivity of the land surface.

Remote sensing technologies play an important role in this process. Various algorithms are used to determine LST, such as the Single Channel and Split Window methods. Each method has its own advantages and limitations. The LST results are displayed in the form of maps, allowing the intensity and spatial distribution of heat islands to be determined. This method also allows for time-based analysis, meaning that temperature changes can be tracked through data from different years, which is important for assessing urban development and environmental changes.

Tashkent is one of the largest cities in Central Asia, with unique natural, climatic and urban features. The city is located in a continental climate zone, with high temperatures and dry weather in the summer months, and relatively cold temperatures in the winter months. These climatic conditions create certain conditions for the formation of heat islands. The urban structure of the city is also one of the important factors. In recent years, large-scale construction work has been carried out in Tashkent, new residential areas and infrastructure facilities are being built. As a result, the area of concrete and asphalt pavements is increasing, and natural green areas are shrinking. This is one of the main factors leading to an increase in the temperature of the city. The increase in the population and the increase in the number of vehicles also affect the urban environment. Heat and gases emitted from transport and industrial sources cause changes in the microclimate. The relative scarcity of water bodies also leads to a lack of cooling factors. Existing parks and green areas in Tashkent play a certain role in regulating the climate. However, their insufficiency does not prevent the intensification of heat islands.

Analysis of the spatial distribution of heat islands in Tashkent allows us to determine how temperatures are distributed in urban areas. Remote sensing data is the main source in this process.

Areas with high and low temperatures are identified through LST maps created based on satellite images. The analysis shows that temperatures are high in the central and industrial areas of the city, and these areas are manifested as strong heat islands. On the contrary, temperatures are relatively low in parks, reservoirs and sparsely built-up areas. This difference indicates the uneven spatial distribution of heat islands. The intensity of heat islands differs in different seasons. This phenomenon increases in the summer months, and decreases relatively in the winter months. The difference between day and night is also important, especially at night the heat remains longer in the city center. The results of the spatial analysis show that a regional approach is needed to reduce heat islands. That is, it is important to develop green infrastructure and control building density in areas with high temperatures.

The factors influencing the formation and intensification of heat islands in urban areas are multifaceted and arise as a result of the interaction of natural and anthropogenic factors. One of the most important factors is the presence and proportion of green areas. Plants cool the environment through the process of evapotranspiration, partially absorb sunlight and increase humidity. Therefore, the reduction of green areas leads to an increase in heat islands. Building density is also an important factor.

The dense location of buildings reduces the return of solar radiation, traps heat and restricts wind circulation. As a result, heat exchange slows down and temperatures increase. This is especially evident in high-rise and densely built-up areas. Transport vehicles also have a significant impact on the formation of heat islands.

The heat released by car engines, gases generated by fuel combustion and the heat-absorbing properties of asphalt roads increase the overall temperature. Industrial enterprises and household energy consumption are also additional sources of heat. The presence of water bodies, the type of land cover, wind direction and humidity also affect heat islands. A comprehensive analysis of these factors allows for effective management of heat islands.

Reducing heat islands is one of the important tasks of modern urban planning. One of the most effective measures in this regard is the expansion of green areas. Trees, parks and green zones regulate the urban microclimate, cool the air and improve the ecological balance. Innovative solutions such as “green roofs” and “green walls” are especially important.

The correct choice of building materials is also important. The use of materials with high albedo (reflecting solar radiation) reduces heat absorption. Whitewashed roofs and cooling coatings are effective in this regard.

Optimization of the transport system also plays an important role in reducing heat islands.

Anthropogenic heat release can be reduced by developing public transport, using environmentally friendly vehicles and reducing the number of cars. In addition, using Remote Sensing and GIS technologies, it is possible to regularly monitor heat islands and develop strategies for their management. This is important for sustainable urban development. A comprehensive approach is needed to reduce heat islands, which requires the integration of environmental, technological and management measures.

### **Conclusion**

The results of this study show that the heat island phenomenon in Tashkent city is formed under the influence of urbanization processes and anthropogenic factors and has a significant

impact on the urban microclimate. In particular, an increase in ground surface temperature is clearly observed in areas with high building density and in areas with a lack of green spaces.

During the study, it was found that the use of remote sensing data is an effective and reliable method for identifying heat islands and assessing their spatial distribution. The results of LST obtained based on satellite images showed an uneven temperature distribution in urban areas and high heat intensity in some zones. The main factors influencing the formation of heat islands were the reduction of green areas, the increase in the number of vehicles, and the expansion of artificial surfaces.

By reducing these factors, the ecological environment of the city can be improved. In order to reduce heat islands in the future, it is necessary to expand green infrastructure, use environmentally friendly building materials, improve the transport system, and introduce modern monitoring methods. This serves to ensure the sustainable development and ecological balance of the city of Tashkent.

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