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Determination of Comfort Zones in Landscape Planning in Niğde

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A R T I C L E I N F O

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A B S T R A C T

Our cities, most of which do not show planned development, are turning into ecosystems that threaten the living life of the natural and cultural environment as a result of many environmental problems such as increasing human and building density and incorrect land use. This negative situation has the opportunity to be resolved with urban planning in which the physical structure of the city is balanced and with landscape plans that will create open and green areas in the city that contribute positively to human and environmental health. The urban heat island effect, which has emerged as a result of intense urbanization in recent years, creates problems for city residents. Unfortunately, most cities in the world face this negative climate phenomenon. It becomes difficult to combat the heat island effect, especially in cities where construction density increases unconsciously. Ecological planning appears as a factor that will prevent these problems from turning into important environmental problems in the future. The most important component to be considered in ecological planning is climate. In this study, thermal comfort areas were tried to be determined along Dr Sami Yağız Street, which is one of the most frequently used areas of Niğde. Temperature and humidity measurements were taken at 25 points at equal intervals on both sides of the street. Measurements were made on different days of the week and at 4 different times during the day. The obtained values were transferred to ArcGIS 10.3 software and maps were produced. A universal linear extension system was used in the evaluation of climate data, and climate factors and bioclimatically suitable areas on the street were determined and evaluated in terms of comfort level. It has been determined that the humidity rate in the study area varies according to measurement hours, and there is no significant change in temperature.

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Introduction

According to the United Nations World Urbanization Reports in recent years, population density in cities has increased significantly (United Nations, 2018). Accordingly, cities are growing day by day and the population density per unit area is increasing. This unplanned urban development negatively affects the quality standards of living spaces and brings with it many environmental problems, from air pollution to increased energy consumption and thermally uncomfortable spaces. At the same time, the residential areas needed to meet the needs of the increasing urban population lead to a decrease in open green areas. In addition to many known physical properties of open-green spaces (Payton et al., 2008; Nordh et al., 2011), they also provide important psychological contributions (Parsons and Daniel, 2002; Carlson 2010; Nordh et al., 2011). There are many studies aiming to determine thermal comfort values in residential areas with different qualities in cities (Unger, 1999; Yılmaz et al., 2007; Bulgan et al., 2014; Dikhan et al., 2018; Canan et al., 2019; Zengin et al., 2019). Many climate models, called simple and complex, are used to determine thermal comfort, and future scenarios can sometimes be produced with meteorological data from past years. In addition to the models used to determine thermal comfortable spaces, the use of thermal cameras has also gained momentum in this field in recent years. Thanks to these cameras, which can also be recorded by unmanned aerial vehicles, surface temperatures can be measured. In climate-focused studies, Thermal Cameras are used to determine the current status of urban living spaces and to work on forward-looking improvement scenarios in designs (Zengin et al., 2019).

Sustainable urban planning approaches aim to control urban heat island formation and develop strategies to reduce this effect. On a macro scale, structural densities, hard ground and green tissue density within the city are tried to be kept in a certain balance. When interventions are aimed at an existing urban fabric or when new urban areas are planned, it is important to predict the microclimatic conditions that may occur during the planning-design stages. Using simulation programs, preliminary information about the microclimatic conditions that are likely to occur can be obtained in a realistic manner in these preliminary planning/design stages.

In order to have information about the microclimate that will occur and to avoid gross mistakes, various scientific studies conducted in the same city or a city in a similar climate zone can be used. In some of these studies, the effects of various parameters that make up the structural environment on the urban climate are discussed and can provide various clues to urban planners, architects and landscape architects.

Within this scope, the study by Oke, in which the urban heat island effect was determined based on average sky openness values (SVF), is a good example to present (Oke, 1987). Again, in scientific studies on urban climate, the methods of obtaining information are obtained with the help of on-site short-term micro-meteorological measurements, long-term meteorological measurements, satellite data or simulation programs. An extensive literature has emerged on this subject in recent years (Canan and Geyikli, 2023).

The structure and characteristics of the urban climate are important issues that need to be addressed in the planning and design process. During the urbanization process, changes in the climate structure occur, albeit unintentionally, through planning and design. Landsberg (1981) emphasized the impact of changes in land use in urban areas on the urban area and climate; It states that in a city where vegetation has decreased by 35%, an area of 20 km^2 will be affected. In this affected area, urban heat island density increases, surface rainwater retention decreases, control of flood events becomes difficult, water management problems emerge, sudden and rapidly changing wind fields occur, differences occur in rain patterns, surface temperature increases, pollutant rate and their distribution is increasing (Balık and Yüksel, 2014).

From past to present, climate has been effective in directing human needs such as settlement, shelter, nutrition and health, which constitute the daily life cycle. The concept of climate, which affects daily life routine, has been tried to be better understood by people for centuries. As the relationship between humans and climate is established, it has been observed that people feel healthier and more vigorous physiologically and spiritually under certain conditions. Accordingly, the concept of bioclimatic comfort is defined as the conditions in which people adapt to their environment by consuming the least amount of energy. Temperature, humidity and wind parameters are evaluated to determine bioclimatic comfort status (Topay and Yılmaz, 2004; Erkek et al., 2020).

Due to the impact of bioclimatic comfort on humans and other living species, it is an important input especially for planning and design processes. Because, in physical planning and design processes, which are mostly carried out to create environmentally compatible and sustainable living spaces, the focus is on providing optimum living conditions for people while preserving environmental and cultural elements. In this context, it is important to evaluate climatic factors in a way that will enable people to live a more comfortable life and to turn them into planning input. In this study, it was planned to evaluate the detailed meteorological and climate analysis and results of Dr. Sami Yağız Street, and to create a design database for landscape planning. This database can be used for bioclimatic assessment of planning and design, climate balanced planning and design criteria as well as other criteria. The regional suitability of the street in terms of thermal comfort was discussed, and the effects of factors such as space use and traffic on heat exchange were determined.

Materials and Method

In the study, it was planned to produce maps of the gases that affect the air quality of Dr Sami Yağız Street in Niğde Province. Niğde is surrounded by Mersin to the south, Konya to the west, Nevşehir to the north, Aksaray to the northeast, and Kayseri to the east (Figure 1). Therefore, the main material of the study was prepared by Dr. Sami Yağız Street and its surroundings. Dr. Sami Yağız Street is one of the longest streets of Niğde Province and is approximately 1.5 km long and 15 meters wide. Dr. Sami Yağız Street is located at 37.966373 latitude and 34.672649 longitude (Figure 2).

Figure 1. Location of the study area

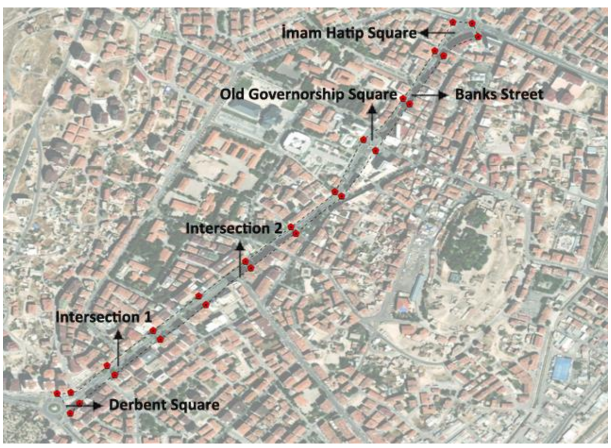

Figure 2. Dr. Sami Yağız Street and measurement points

Temperatur and humidity measurements were made at 25 points at equal intervals on both sides of the street. Measurements were made on weekdays. The reason for this is that the street is exposed to heavy traffic on weekdays, especially for reasons such as school, work, etc. In addition, measurements were made on weekdays to determine the effects of the restaurants on the sides of the street on air quality. After determining the days to be measured, the time period in which the measurement would be made was discussed. As a result of the observations, the street is heavily used at 09:00, 12:00, 15:00 and 18:00. 09:00 and 18:00 are the time period for going home, work, and returning to school, work, etc. It is used intensively in the 12:00 and 15:00 time zones for various reasons (eating, public, banking, etc.). The obtained values were transferred to ArcGIS 10.3 software and maps were produced. Through the maps, it was determined in which time periods the temperature and humidity values changed, in which parts of the street the temperature and humidity levels changed and the reasons why.

Results and Discussion

The warm season in Niğde is 3.5 months long and starts on June 13 and lasts until September 22, with the average daily high temperature being over 24°C. The cold season is 3.5 months long and starts on November 29 and lasts until March 10, with the average daily high temperature below 8°C. The coldest month in the Niğde is January; The average low temperature in this month is -5°C, while the high temperature is 3°C. The hottest month is July and the average temperature is around 30°C. For this reason, measurements were made in January. The obtained values were interpreted according to seasonal temperature norms. The results of the measurements for temperature are given in Figure 3-6. It was determined that the temperature values in the study area varied between 0°C and 8°C on average. According to the data received from the General Directorate of Meteorology, taking into account the years 1935 - 2022, the lowest average temperature in January, when the study was conducted, was determined as - 0.3°C, the lowest temperature was -4.6°C, and the highest temperature was 4.8°C.

This study was conducted at 09:00, 12:00, 15:00, 18:00 and it was determined that the temperature values were above the average values considering the regional conditions. It has been determined that the temperature value increases by approximately 1-2°C from east to west of the area. The highest temperature values on the street were reached between 12:00 and 15:00, and the lowest temperature values were reached in the measurements made at 18:00. The areas with high temperatures are Derbent Junction, Imam Hatip Square and the points where the Old Governorship Square is located. According to the temperature values of January 2023, it was determined that the average temperature was 8 degrees and above (Figure 7).

Compared to the average of previous years, there is warmer weather in 2023. According to the measurement results, the average temperature of the street is close to this value. The results of the measurements for humidity are given in Figure 8-11. It was determined that the humidity values in the study area varied between 36% and 90% on average.

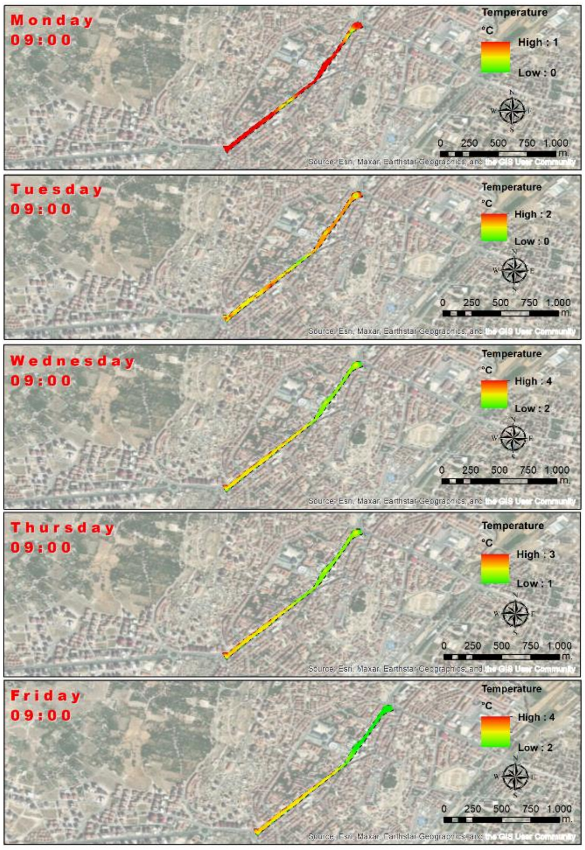

Figure 3. Temperature measurement – 09:00

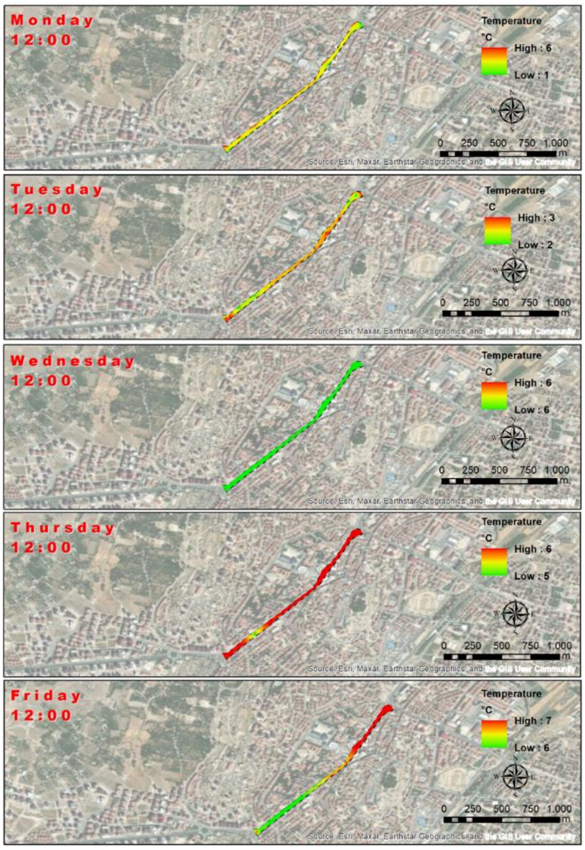

Figure 4. Temperature measurement – 12:00

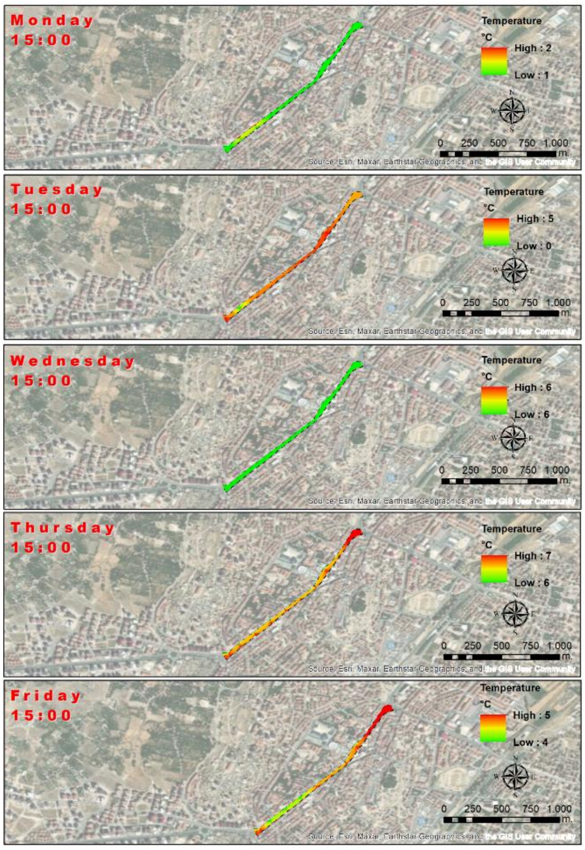

Figure 5. Temperature measurement – 15:00

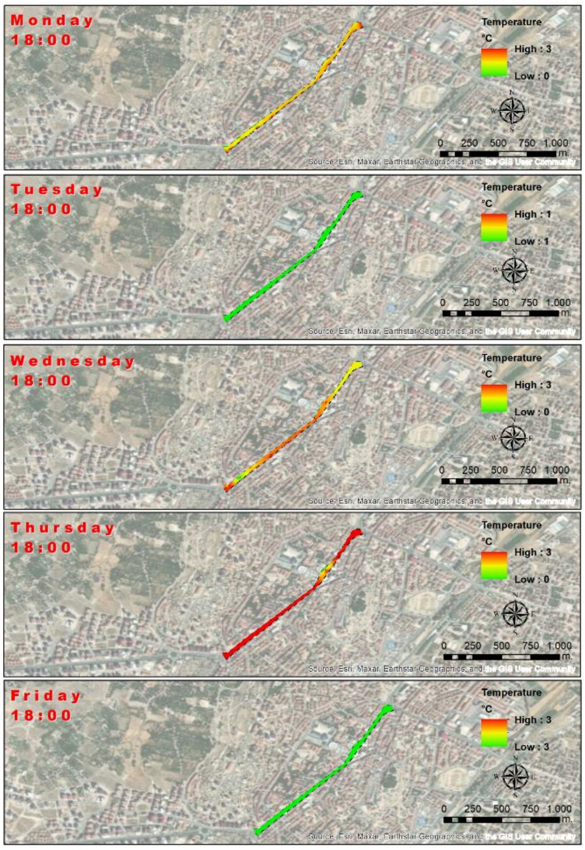

Figure 6. Temperature measurement – 18:00

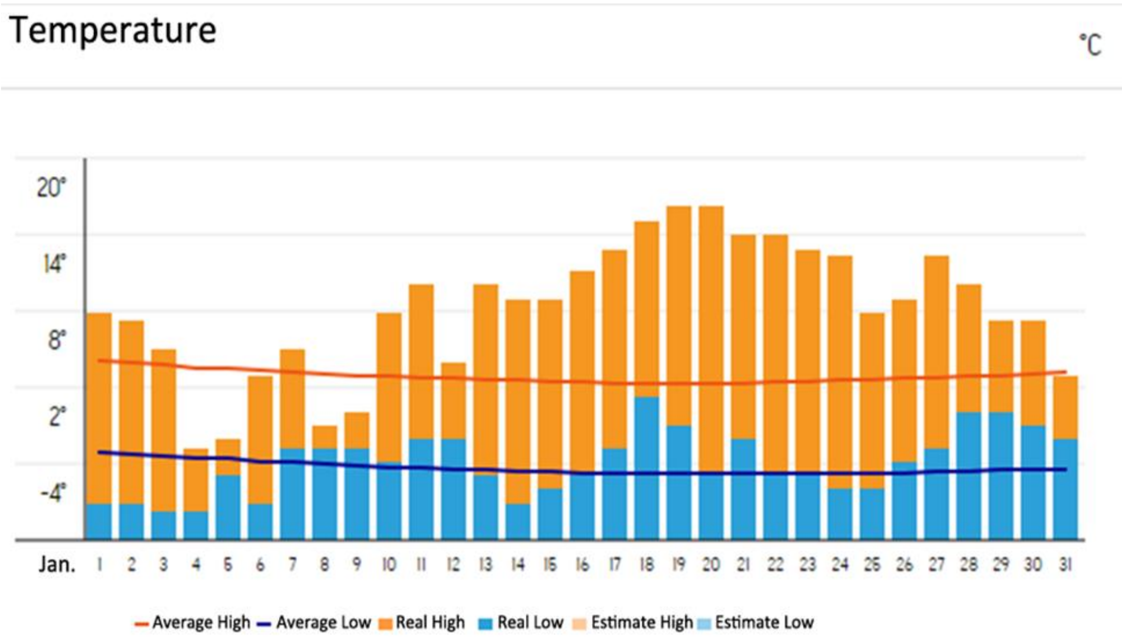

Figure 7. January temperature data (Anonymous, 2023)

According to the data received from the General Directorate of Meteorology, taking into account the years 1935 - 2022, it was determined that the lowest ambient humidity was 20%, the lowest humidity was 10% and the highest humidity was 75% in January, when the study was conducted.

It was determined that the humidity values, as well as the temperature data, were compatible with the previous climate data. Considering that the temperature values of January 2023 are above the average values of previous years, it is expected that the humidity value will also increase. The highest average humidity values on the street were reached in the 12:00 and 15:00 time periods, and the lowest average humidity values were reached in the measurements made in the 18:00 time period. The areas with high temperatures are Derbent Junction, Imam Hatip Square and the points where the Old Governorship building is located.

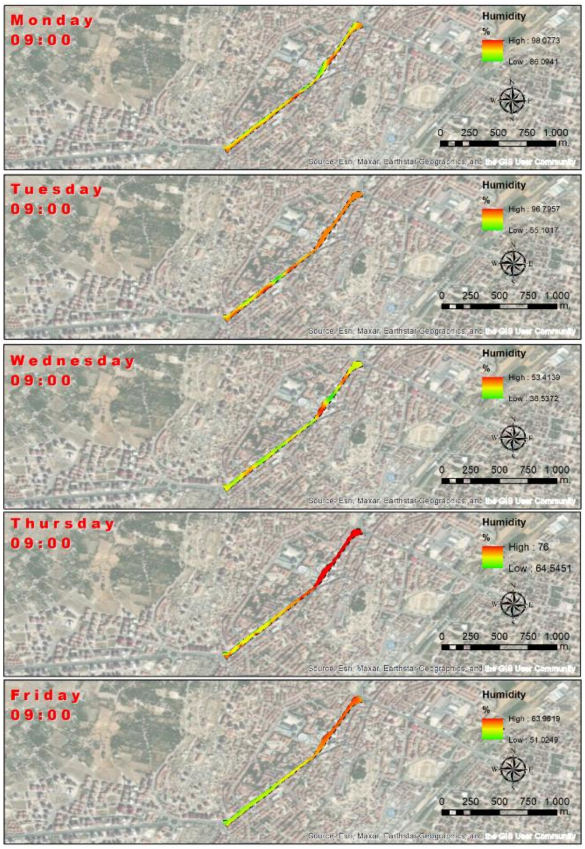

Figure 8. Humidity measurement – 09:00

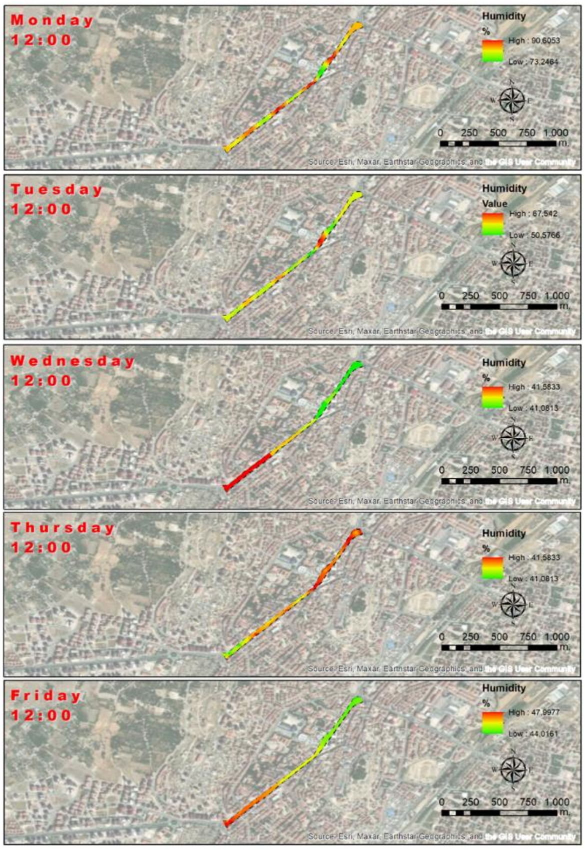

Figure 9. Humidity measurement – 12:00

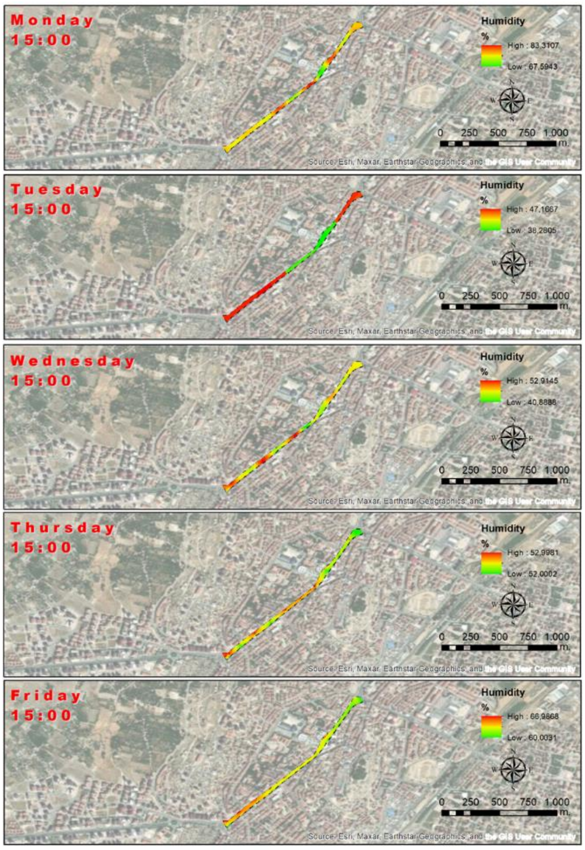

Figure 10. Humidity measurement – 15:00

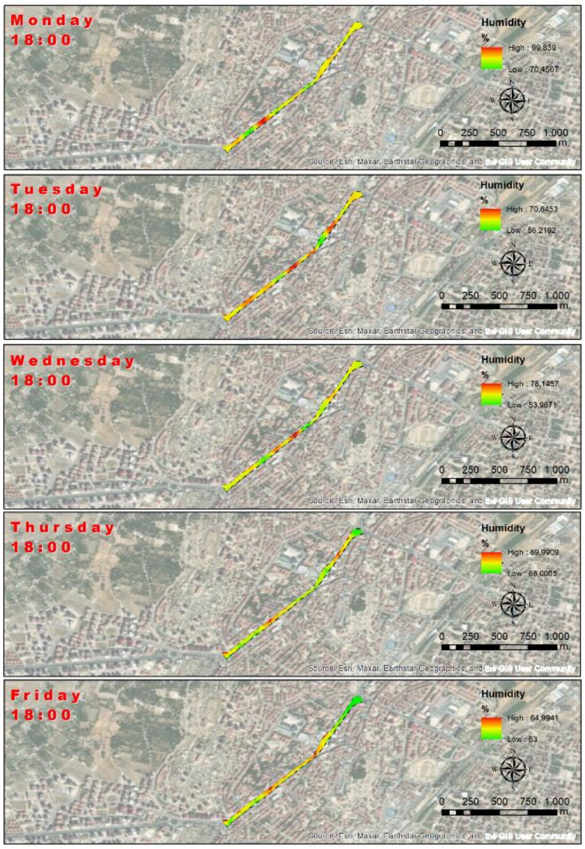

Figure 11. Humidity measurement – 18:00

Figure 12. Dr. Sami Yağız Street

Conclusion

In Turkey, studies on determining bioclimatic comfort areas are increasing day by day. Cetin et al. (2010) examined the bioclimatic comfort areas for Kütahya province in line with the landscape architecture profession and determined suitable areas for landscape activities in line with the landscape planning criteria. In another study, bioclimatic comfort areas suitable for landscaping activities in Kastamonu city center were determined (Çetin, 2015). Kestane and Ülgen (2013) determined bioclimatic comfort zones for İzmir province with the help of GIS. Çetin (2016) examined the determination of bioclimatic comfort areas in landscape planning using the Cide coastline example. This study is similar to other studies in terms of method. However, since the climatic characteristics and land use of the study areas will differ, it is not possible to compare the results. When all the data obtained were evaluated, it was determined that almost the entire region was suitable in terms of thermal comfort, considering the average data of the month in which the measurements were made. It has been determined that the buildings on the street further reduce the climatic comfort conditions. The climatic comfort value range for January in Dr. Sami Yağız Street is at an optimum level between 0-10°C with an average temperature of 8°C. Humidity comfort values vary. GIS map results show that Dr. Sami Yağız Street generally has suitable space for climatic comfort in large areas or square areas.

As a result of the study, it was determined that approximately 52.48% of the total area of Dr. Sami Yağız Street was suitable for climatic comfort. Climatic comfort areas with negative values are mostly located in the northeastern part of the street. It has been determined that this result is caused by the narrowing of the road width and the high building density in these parts of the street. High humidity values in this region reduce climatic comfort values. The southern part of the street has wider roads and more empty areas. Accordingly, with the influence of the aspect of the area, increasing sunshine duration causes the temperature to increase. High temperature and humidity levels in this region reduce bioclimatic comfort values. Landscape architecture and planning can be improved by applying bioclimatic comfort conditions principles and design criteria. Planning and bioclimatic comfort design in the wrong conditions can create extremely adverse conditions. In this study, Dr Sami Yağız street was examined in terms of bioclimatic comfort. The study results show that most of the street is suitable for bioclimatic comfort.

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References

Anonymous. 2023. https://www.accuweather.com/tr/tr/nigde/319795/january-weather/319795. Accesed Date: 11.09.2023

Balık H, Yüksel ÜD. 2014. Planlama sürecine iklim verilerinin entegrasyonu. Türk Bilimsel Derlemeler Dergisi, (2), 1-6.

Bulgan E, Yılmaz S, Matzarakis A, Irmak MA. 2014. Quantification of summer thermal bioclimate of different land uses in an urban city centre. IC2UHI3, October 13-15 2014, Venezia, Italy, pp: 523-534.

Canan F, Golasi I, Ciancio V, Coppi M, Salata F. 2019. Outdoor thermal comfort conditions during summer in a cold semi-arid climate. A transversal field survey in Central Anatolia (Turkey). Building and Environment, 148, 212-224. https://doi.org/10.1016/j.buildenv.2018.11.008

Canan F, Geyikli HB. 2023. Dış Mekân Gölgeleme Elemanlarının Termal Konfor Koşullarına Etkilerinin Değerlendirilmesi. Yüzüncü Yıl Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 28(2), 684-694. https://doi.org/10.53433/yyufbed.1215174

Carlson A. 2010. Contemporary environmental aesthetics and the requirements of environmentalism. Environmental Values, 19(3), 289-314. https://doi.org/10.3197/096327110X519844

Çetin M. 2015. Determining the bioclimatic comfort in Kastamonu City. Environmental monitoring and assessment, 187, 1-10. https://doi.org/10.1007/s10661-015-4861-3

Cetin M. 2016. Determination of bioclimatic comfort areas in landscape planning: Cide coastline example. Turkish Journal of Agriculture-Food Science and Technology, 4(9), 800-804. https://doi.org/10.24925/turjaf.v4i9.800-804.872

Cetin M, Topay M, Kaya LG, Yılmaz, B. 2010. Efficiency of bioclimatic comfort in landscape planning process: case of Kutahya. Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi Seri A, (1), 83-95.

Dihkan M, Karsli F, Guneroglu N, Guneroglu A. 2018. Evaluation of urban heat island effect in Turkey. Arabian Journal of Geosciences, 11, 1-20. https://doi.org/10.1007/s12517-018-3533-3

Erkek E, Kalaycı Ö, Başaran N, Ayça Ö, Rutkay A, Lamba H, Ağaçsapan B. 2020. Examining the relationship between bioclimatic comfort and land use using GIS and RS techniques: The example of Izmir province. Afyon Kocatepe University Journal of Science and Engineering Sciences, 20(1), 174-188. https://doi.org/10.35414/akufemubid.634985

Kestane Ö, Ülgen K. 2013. Determination of bioclimatic comfort zones for Izmir province. Journal of Technical Sciences, 3(1), 18-25.

Landsberg HE. 1981. Urban Climate (1st ed.). London, UK:Academic Press. ISBN: 0-12-43-5960-4, 271 p.

Nordh H, Alalouch C, Hartig T. 2011. Assessing restorative components of small urban parks using conjoint methodology. Urban forestry & urban greening, 10(2), 95-103. https://doi.org/10.1016/j.ufug.2010.12.003

Oke TR. 1987. Boundary Layer Climates (2nd ed.). London, UK: Routledge, Taylor & Francis Group. ISBN: 9780203407219, 464 p.

Parsons R, Daniel TC. 2002. Good looking: in defense of scenic landscape aesthetics. Landscape and Urban Planning, 60(1), 43-56. https://doi.org/10.1016/S0169-2046(02)00051-8

Payton S, Lindsey G, Wilson J, Ottensmann JR, Man J. 2008. Valuing the benefits of the urban forest: a spatial hedonic approach. Journal of environmental planning and management, 51(6), 717-736. https://doi.org/10.1080/09640560802423509

Unger J. 1999. Comparisons of urban and rural bioclimatological conditions in the case of a Central-European city. International Journal of Biometeorology, 43, 139-144.

United Nations, 2018. The world's cities in 2018: data booklet. Department of Economic and SocialAffairs,http://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf. (Accessed date: July 26, 2023)

Topay M, Yılmaz B. 2004. Having Bioclimatic Comfort Using GIS to Determine Areas Possibilities: Muğla Province Example. Proceedings of 3rd GIS Days in Turkey, 425-434.

Yılmaz S, Mutlu E, Yılmaz H. 2017. Effects of Plant Usage on Urban Thermal Comfort for Sustainable Cities. 8th Atmospheric Science Symposium, Oral presentation, ATMOS 2017, 1-4 November 2017, İstanbul, Istanbul Technical University, pp: 712-719.

Zengin M, Yılmaz S, Mutlu BE. 2019. Analysis of Atatürk University Campus Thermal Camera Images in terms of Spatial Thermal Comfort. Ataturk University Faculty of Agriculture Journal, 50(3), 239-247. https://doi.org/10.17097/ataunizfd.535209