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Mapping of bioclimatic comfort for potential planning using GIS in Aydin

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Abstract People are relaxed (satisfied or well-off) in what is described as comfortable climatic conditions. In such conditions, a person's energy balance is not disturbed because of stresses from extreme heat or cold. Bioclimatic structure has been well researched and should be a consideration in the planning process for arranging comfortable spaces. It represents the understanding that energy balance is one of the basic elements of a sustainable landscape design. The goals of this study have been to create ideal places for human thermal comfort and to advance objectives focused on the importance of sustainable and ecological landscape planning and design work, along with their accompanying economic benefits. In this study, which focuses on the climate of the Province of Aydin, the most suitable areas for bioclimatic comfort have been identified. The climate values for the Aydin Province have been taken from a total of 22 meteorological stations. Stations at altitudes ranging from 11 to 871 m were used to note the climate changes that occurred. The average temperature, relative humidity, and wind speed from each station, including data collected using Geographic Information System (GIS) software, were

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transferred. GIS maps were then created from the imported data, and areas of optimal comfort around the city of Aydin were determined. The results show the range that is suitable for a bioclimatic comfort zone in Aydin. The bioclimatic comfort range was determined to be roughly 17 °C for Aydin, and the city of Aydin demonstrated a comfort range between 14 and 19 °C. As a result, the city of Aydin was shown to be a suitable area for bioclimatic comfort.

Keywords Aydin · Bioclimatic comfort · GIS · Landscape planning · Sustainability

1 Introduction

The meaning of sustainable development is to meet the needs of today without putting at risk the capacity of future generations. One of the most important tools of sustainable development is sustainable planning. Sustainable planning permits the fulfillment of expected functions without losing the value of the planning components that make up natural resources; it can also be seen as incorporating the preservation of cultural resources. Using sustainable planning, the main objective of development capacity is to achieve a targeted socioeconomic status while upgrading quality of life and preserving the environment. In this way, sustainable planning provides a smooth transfer of resources to future generations. Since 1970, sustainable development, ecological approaches, and concepts for ecologically sensitive planning in the prevention of environmental pollution have been widely used in the planning process. The main element of physical planning is ecological planning, which involves planning to achieve ecological targets. The main objective of management, planning, and design is to consider natural and artificial ecological planning criteria in order to increase the environmental efficiency of the project. Ecological planning is an integrated planning system. This system may be disposable within a local domain, but when using a large target area and examining the effects of land-use decisions, it is essential to ensure that the projected area does not cause environmental problems. The concept of sustainability (that is, the efficient use of natural and cultural resources) is an integral part of ecological planning. Thus, natural, artificial, and social resources are all parts of the protected ecological planning system (Altunkasa 1990; Cetin et al. 2010; Topay 2012; Kestane and Ulgen 2013; Demir et al. 2014; Cetin 2015).

Olgyay (1973) states that the bioclimatic comfort value, the temperature value ranging from 21.0 to 27.5 °C, % 30–65 relative humidity, and 5 m/s wind speed are taken in combination and used in bioclimatic evaluation. Many climate indices and bioclimatic comfort conditions such as temperature and humidity are evaluated, sometimes alone, sometimes including wind elements, based on the all-in-one combination. Most of the criteria used in determining comfort are "chill temperature." Thermal comfort is more effective when compared to 80% comfort levels in the creation of bioclimatic comfort. Bioclimatic comfort in this context has been examined under the name "human comfort temperature" in many literatures. Turkey's bioclimatic comfort in the middle latitudes, in which the temperature, humidity, and wind vary depending on temperatures between 17.0 and 24.9 °C, are considered to be the perceived temperatures. The factors affecting bioclimatic comfort are defined as the following six items in order of importance, the first four of which are related to atmospheric conditions, and the last two of which are personal parameters. These factors are air temperature (dry-bulb temperature), atmospheric humidity, air movement, radiation (the mean radiant temperature of the environment), activity-dependent metabolic rate, clothing insulation, and evaporative resistance. These fundamental factors as well as the number of hot days, the weather, pests, and diseases that occur due to weather events, air pollution, and the amount of oxygen in the atmosphere affect human comfort. When considering all these effects at once, this comfortable situation is called "bioclimatic comfort" (Cetin 2015). There are many studies about climate variety, including one conducted in Pakistan using land surface temperature and rainfall taken from satellite information. The study concluded that there was a controlled climate on grassland and explained the difference in temperature and rainfall for bioclimatic comfort (Abbas et al. 2015). Another study shows that a climate event which affects refugees is the change in indices, which significantly affects health problems. Extreme weather phenomena or events could strongly affect regional climates (Molla et al. 2014).

Ali et al. (2013) stated that a model found changes and the effects of carbon on climate was used for adaption plans in Asia. Ali and Abbas (2013) researched the effect of carbon dioxide on climate change in the city and its effect on vegetation. Bioclimatic comfort criteria may participate in the structure of the landscape planning process by introducing a climate with balanced criteria.

Determining a suitable bioclimatic comfort area deals first with as evaluating bioclimatic comfort conditions such as temperature, relative humidity, and wind conditions. In addition to these basic factors, radiation, the number of hot days, the rainfall situation, emerging pests and diseases due to air pollution events, and the amount of oxygen in the atmosphere also affect human comfort. All of these effects should be determined considering several bioclimatic comfort conditions. In particular, the three main factors: temperature, relative humidity, and the identification of suitable areas for wind biocomfort areas have also been evaluated because they provide accurate data for the conclusion of the most obvious effects of sustainable landscape planning. For this reason, the value ranges of the three criteria set for Olgyay's landscape planning for biocomfort values were used (Cetin 2015).

Therefore, these three criteria (temperature, humidity, wind) for identifying areas with bioclimatic comfort and benefitting from the opportunities in this study were prepared in GIS mapping, and a map of the bioclimatic comfort in the Province of Aydin was prepared. The effects of extreme weather phenomena or events are relevant for regional areas, and especially cities, in many aspects. Urban cities are the means of human activity, and the amount of people and evaluates endangered by extreme weather phenomena is large, also along the current climate. Extreme weather phenomena have always had and will keep having significant results for cities. Exposure to extreme weather phenomena is perpetrated by climatic conditions, which can be affected by anthropogenic climate change factors. While extremely significant weather phenomena or events could strongly affect the regional climate, as these events are not climatic as such, they are not explained here. In addition to the factors of wind speed, temperature, and relative humidity, other factors such as pressure and solar radiation at high-altitude area could influence comfortable climate conditions. Solar control is excellent, with very well-insulated buildings for shading the outer cavity.

Solar radiation is considered an essential case for cooling when the environment is occupied, as well as decreasing external shade. The physiologically equivalent temperature was mainly affected by pressure and solar radiation in high-altitude areas. Lin et al. (2006) reached the conclusion that shady places in Taiwan may support to increase direct solar radiation and ensure relaxed areas for the weather domestic areas in outdoor environments. The fact that different high altitudes, like those found in tree species, lead to different degradations in solar radiation and, after all, a different influence on relaxed conditions like wind was also verified by this research. Urban morphology and shapes generate microclimates that have an impact on the inner and outer spaces.

Climate is the most important factor that determines lifestyle, because it is one of the key components that must be taken into account in planning structures within an ecological climate. Weather and climate have an impact on people's behavior and their physiological states. Research has shown that climatic changes have an impact on people's physiological and emotional responses and, consequently, on people's performance. In comfortable climatic conditions, these responses are positive. Thermal comfort or climatic condition can be identified by the "inform of brain that reflects pleasure with the thermal environment" in the sense that people are healthy and not subject to stress due to the dynamic weather conditions imposed on them (Topay 2013; Topay and Parladir 2015; Cetin 2015).

Some climate parameters have gained particular importance in facilitating people's bioclimatic comfort, including six important parameters. Four of them are related to humidity, while radiation is associated with climatic conditions such as wind and temperature. There are some regions where adverse changes in bioclimatic comfort, such as cold sweat forming on the human body, occur (Kocman 1991; Gumus 2012; Toy and Yilmaz 2009; Topay 2013; Topay and Parladir 2015; Cetin 2015).

The comfort index can be calculated using Fanger's predicted mean vote (PMV) equation, the most common international biometeorological estimator of the average thermal perception index (Fanger 1970).The Physiologically Equivalent Temperature (PET) is another important biometeorological indicator. This index takes into account aspects of climate, such as wind, radiation, humidity, and temperature, and it uses them to indicate how human beings react to such parameters in a result-based analysis, combining the physical properties of the index. Bioclimatic maps indicating spatial frequency for exceeding the thermal index have been produced using this method. These maps are now available in different sizes—as maps of cities, regions, and countries, and even as a world map (Ozsahin et al. 2015; Olgyay 2015; Topay and Parladir 2015; Cetin 2015; Cetin and Zeren 2016).

Using such bioclimatic maps, comfort zones and areas can be found, and the data they provide are very important for sustainable landscape planning. These maps can be produced for many indices relating to thermal comfort. With regard to the planning process, these maps provide valuable input into urban and rural planning, ecological and economic decision-making, land-use planning, recreation, and tourism planning. When taken into account in the dimensions of urbanization, such maps—especially the tourism map—can provide important clues in determining the best locations for recreation and residential areas (Olgyay 2015; Topay and Parladir 2015; Cetin 2015; Cetin and Zeren 2016).

Landscape design and incorporation of climate data should be addressed when selecting recreational and living areas. This is preferred, along with the stability of planning climatic areas and the progression of design. This progress involves a detailed review and analysis of the issues for users in large-scale city planning and design. This analysis takes into account the sensitivity of the system's economic, aesthetic, ecological, meteorological, and functional aspects in establishing a comfort zone, along with the goals of sensory and visual gratitude. This stage will reveal a space synthesis of meteorological, ecological, functional, and aesthetic considerations and must emerge as an economically viable plan. This step may find that different considerations suggest different comfort zones; therefore, monitoring the process and determining a result must be accomplished by synthesizing these results. All the characters of meteorological values play a crucial role in guiding landscape architecture, landscape management, landscape planning, landscape design, and urban planning. Meteorological parameters are extremely necessary in developing new residential areas as well as in selecting disposable requirements. People may feel more comfortable in the temperature sensed, and so bioclimatic map locations may be used to select new settlements. As such, bioclimatic maps can ensure that the areas made available for residential use are more undisturbed. Done correctly, this planning uses a number of factors, obtained from the analysis of the meteorological parameter map, to aid in the landscape design. For example, if through detection of meteorological parameters an open area with a couple of productive days per year can be identified, it can be used as the site for design of a swimming pool (Cetin 2015; Cetin and Zeren 2016).

A physical and socioeconomic development forecast is one of the essential indexes for making an urban plan. The bioclimatic comfort of urban planning is one of the most important parameters that should be evaluated, in terms of suitable areas for human health. Bioclimatic comfort ranking ranges are shown here for the country of Turkey. This range offers people the best situations for being healthy themselves. Bioclimatic situations can have an impact on people's ability to feel comfortable and relaxed, and these depend on several elements, including wind and meteorological variables, kinds of radiation, and moisture. Health, clothing, and kinds of activities are also elements of comfort. A bioclimatic comfort temperature range is defined as the range wherein people feel comfortable in the detected temperature environment (Cetin 2015; Cetin and Zeren 2016).

A study of Aydin was initiated to allow for elaborated climatic analysis and to evaluate the conclusions provided by a planning database of landscapes. This planning and design database includes criteria such as climate-balanced planning and design to demonstrate the creation of bioclimatic ratings.

2 Material and method

Aydin constitutes the study area used to consider climate values. According to the research, the Aydin Province creates the potential for climate differentiation, as it covers both rural and urban landscapes. Meteorological data show that Aydin's position is suitable in terms of climatic comfort. A climate-based landscape planning assessment is used by examining the data obtained from Aydin's stations.

Aydin is located between 37°49′8″ and 27°49′8″ in the western part of Turkey. Aydin is bordered by the Aegean Sea to the west. Aydin's world position is shown in Fig. 1. Aydin's elevation is 64 m. Its area is 7943 km^2 as shown in Fig. 2. Aydin's climate is influenced by its Mediterranean location. The climate and topography of Aydin and its cultivation of two different plant communities (shrubs and forests) have led to improvements in its climatic comfort. The rainiest season is winter. There is little to no rainfall in the summer season. Snowfall is rare. Aydin is particularly vulnerable to air coming from the west, with a wind direction from the southwest-west rather than the east-southeast. Aydin is a province of the Aegean Region, with a city of the same name as the province in the center. Izmir and Manisa lie to its north, Denizli is in the east, and Muğla is in the south.

Under the influence of the Mediterranean climate, the city's summers are very dry and hot, and its winters are very mild and rainy. Meander Valley intervenes to contain the effects of the sea. The average annual temperature is 17.7 °C. The area averages 8.1 °C in cold seasons, while August is the hottest month, with an average temperature of 28.2 °C. Temperatures in coastal and lowland areas occasionally exceed 40 °C. The high springs are

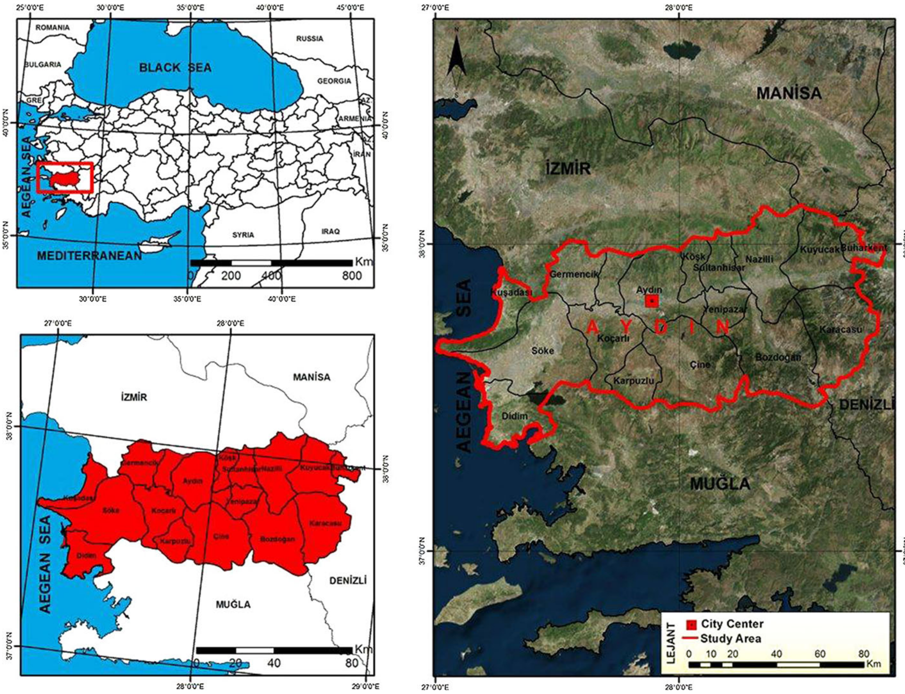

Fig. 1 Geographical information of research areas

Fig. 2 Showing the digital evaluation model of Aydin

cooler, recording a highest temperature of 43 °C (in 1958) and lowest temperatures of −11 °C (in 1942). The average rainfall is 677.5 mm, with 145.1 as the wettest mm/year range, and 2.2 mm/year in August, its driest month. The western region is particularly under the influence of air flow from the Aegean Sea.

Common vegetation bears the characteristics of the Mediterranean climate. As a result of deforestation, the scrub community in some places starts immediately behind the coast and rises to 500–600 m in altitude. Moving inward from the slopes of the valley, the scrub communities show a wide distribution, particularly on the south-facing slope, moving higher up into the forests. After reaching 500–600 m on the north and south slopes, the mountain forests begin, with broad-leaved trees in the majority of low and high altitudes, including coniferous pine, oak trees, and larch. Stone pine is found in the Beşparmak and Madranbab Mountains. Dry forest and undergrowth cover are of poor quality in forested areas, which cover 38% of the province's total surface area (Fig. 3).

In this study, a database map is used to model and process the information. Graphic map data are provided by a geographic information system (GIS).It was first carried out through climatic data collected within specified research areas. The research area's climatic data were then turned to an annual average rate, indicated in the map incorporated with it. Primarily, annual wind temperature and humidity maps were formed. These climatic features were evaluated in terms of the climate comfort of the Aydin Province based on the theoretical essentials of the research.

This study ensures the most correct map of the climatic data field. For the mapping formula, the universal option of the linear kriging interpolation with ArcView GIS, ESRI software is used. Aydin's climatic factors and bioclimatically appropriate places have been determined and evaluated in the light of the levels of bioclimatic comfort values.

In the digital elevation model (DEM), the physical earth, dividing regularly, includes a vertical datum based on values defined by height-cartographic representation, which is a numerical method. Literally representing the physical world of the digital elevation model is not possible in practical terms because of the lack of definition of all points on the surface. Therefore, with the help of sampling points, suitable interpolation points required in the new frequency on the model were created using methods generated. The location and altitude of these points are expressed numerically, calculated along with the land surface.

Maps of climatic factors are one of the most suitable interpolation methods, along with the co-kriging interpolation method. This method is an improvement over the kriging interpolation techniques. In this method, the correlation between the two data sets and

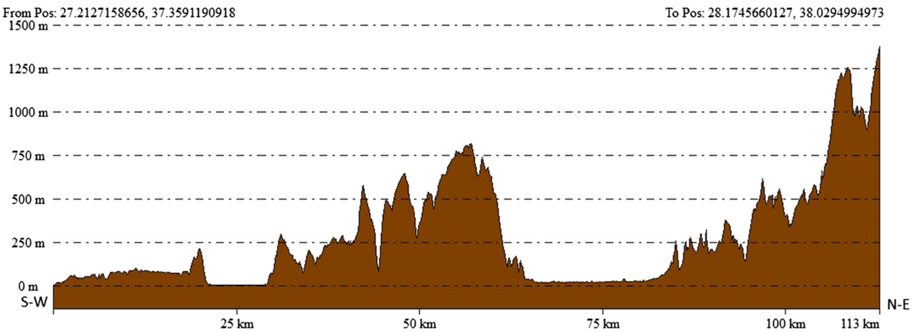

Fig. 3 Showing the profile area of Aydin

relationship with (altitude and temperature, altitude-wind, altitude, humidity, etc.) co-kriging interpolation technique is applied.

The purpose of the method: While forming a map of the geographical variables, taking into account the climatic elements using GIS techniques, the objective is to develop a method that makes accurate mapping and enters the interpolations. The creation of the model is linked to non-empirical methods and verification using data obtained from meteorological stations. The statistical method is connected to the verification of the compliance analysis and multiple regression analysis.

In this study, applying the co-kriging techniques associated with the climatic elemental factors of temperature, humidity, and wind maps by using the digital elevation model in Aydin Province have been tried to show in the best way. Our work in the future, a similar Vertical Direction analysis, will also conduct a comparative analysis, along with co-kriging analysis.

Nikolakis: Compared with 2007, climate change is one of the most important issues of our time. Climate scientists, ecologists, geographers, biologists, biochemists, botanists, environmental engineers, foresters, hydrologists, and geologists show interest. One or more climate parameters, temperature, humidity, and rainfall, are the results of the change. Changing these parameters can disrupt the human heat balance and spark the need to improve the individual's comfort bioclimatic conditions as a result.

Due to Aydin's geographical location, high topography in Turkey, the sea in the winter, harsh climate conditions in remote areas, and the coast in the summer due to the gradually increasing threshold effect of global warming, outdoor recreational activities are limited. The Aydin Province on the Aegean Sea coast, the province most affected by global warming, is beginning to see the gradual collapse of this bioclimatic comfort zone.

Climate variables (temperature, relative humidity, etc.) can lead to stress on the human body and health problems at certain values. The levels that may cause stress on the human body have been suggested by various formulations and scales. Of these, the most commonly used worldwide are the discomfort temperature–humidity indices (discomfort indices). The temperature–humidity index was produced by the U.S. Weather Bureau in Washington in 1959, by the C. Climatology Chamber working with E. Thom. This index considers the relationship between temperature and humidity in order to find the values that may cause stress on the human body. Thom's index has been formulated as follows in Eq. 1 (Thom 1959):

$$\mathrm{DI} = T - (0.55 - 0.0055\mathrm{RH})(T - 14.5) \tag{1}$$

where DI = temperature–humidity index (discomfort indices); T = average monthly temperature in °C; and RH = relative humidity.

The data were also combined with the program Rayman 1.2 (Matzarakis et al. 2010). Thom (1959) took to Eq. 1 (Toroglu et al. 2015). For this study of Aydin in the Aegean Sea, data from 22 weather stations run by the Turkish State Meteorology Affairs General Directorate of Aydin (TSMS 2016) were collected, including measured temperature and relative humidity data at 14:00, which were reported in 1960 and in 2013. In this study, higher temperatures were found when compared to the moisture level sensed temperatures, and the report equation is calculated as follows in Eq. 2 (Steadman 1979):

$$
\begin{aligned}
\mathrm{Te} = {} & -42.379 + (2.04901523 \times T) + (10.1433127 \times \mathrm{RH}) \\
& - (0.2247554 \times T \times \mathrm{RH}) - \left(6.83783 \times 10^{-3} \times T^2\right) \\
& - \left(5.481717 \times 10^{-2} \times \mathrm{RH}^2\right) + \left(1.22874 \times 10^{-3} \times T^2 \times \mathrm{RH}\right) \\
& + \left(8.5282 \times 10^{-4} \times T \times \mathrm{RH}^2\right) - \left(1.99 \times 10^{-6} \times T^2 \times \mathrm{RH}^2\right)
\end{aligned} \tag{2}
$$

where RH = relative humidity (0 and 100%), T = the ambient dry-bulb temperature (°F), and Te = the effects of temperature

These data offer meteorological parameters for use in the choice of new parameters for residential design, and to achieve results from these data, it is of utmost importance to analyze them by GIS. Thus, research areas' temperature for bioclimatic comfort parameters and the impacts of these parameters on climatic elements were determined by evaluating the humidity and wind speed. As noted, this study was prepared with data from 1960 to 2013, and the resulting maps are presented in Figs. 4, 5, 6, 7, and 8, using the above formula to observe the maximum daily temperature measurements at 14:00 by comparison of Aydin's-sensed temperature to the temperatures reported by 22 weather stations, as shown in Table 1.

3 Results

The bioclimatic comfort values of Aydin Province are considered in this study, with the aim of determining the average annual temperature, humidity, and maps created in the GIS environment of the wind element, in terms of their impact on bioclimatic comfort values. Investigation of bioclimatic comfort is based on the use of the following values for determining the parameters of bioclimatic comfort for each element:

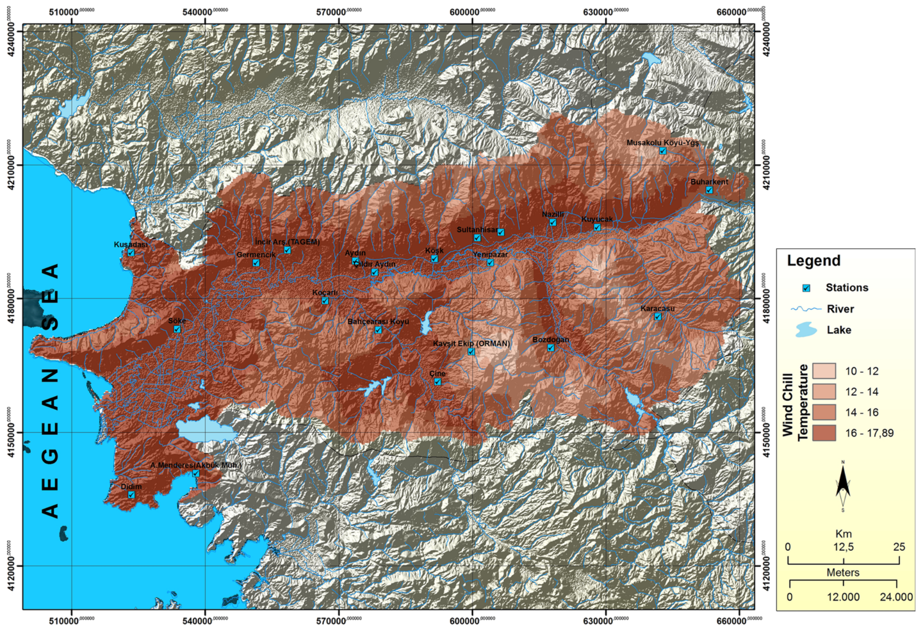

Fig. 4 Annual sensed wind chill temperature map

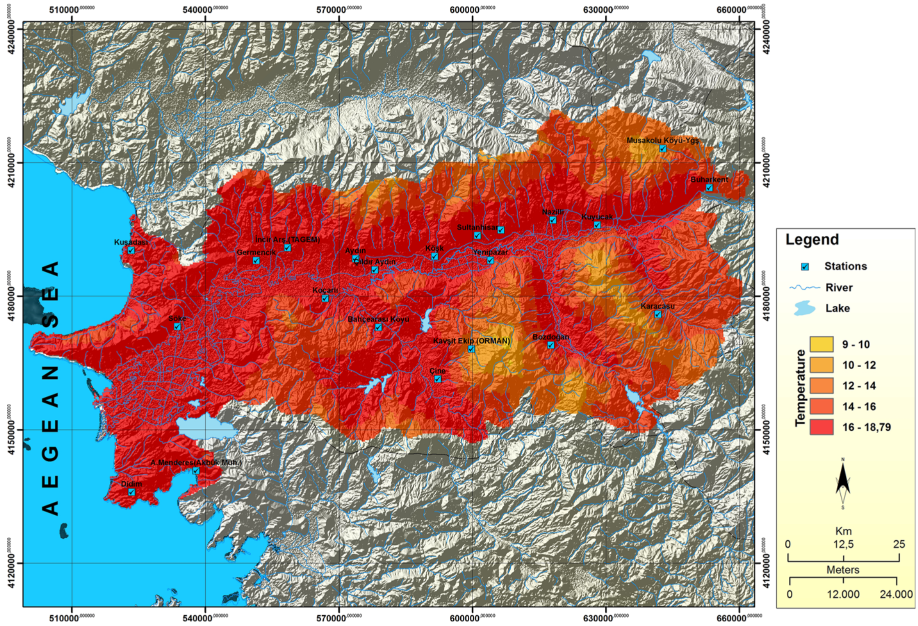

Fig. 5 Research areas' temperature values

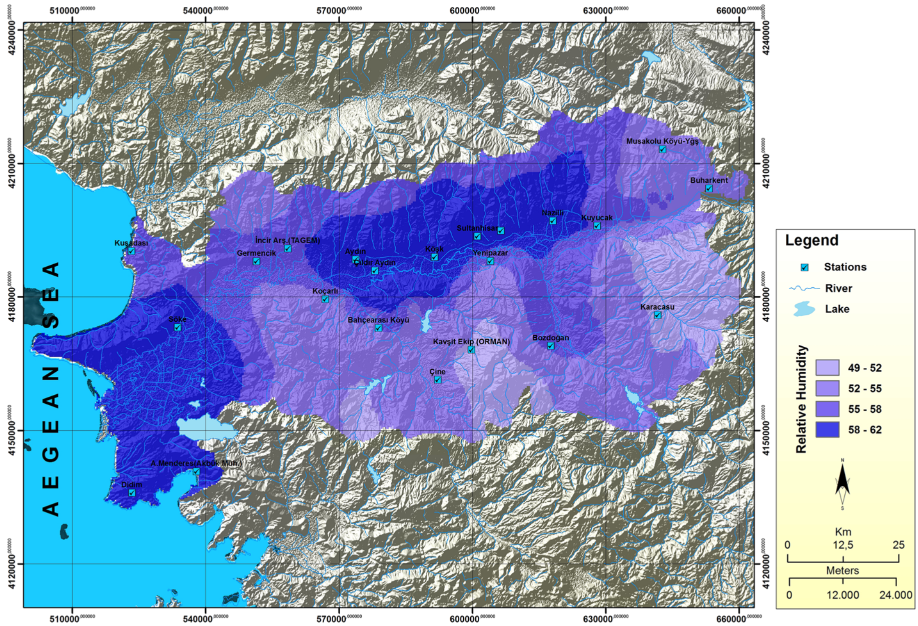

Fig. 6 Research areas' relative humidity values

Temperature = 15–27 °C.
RH = 30–70%.
Wind speed = 0–5 m/s.

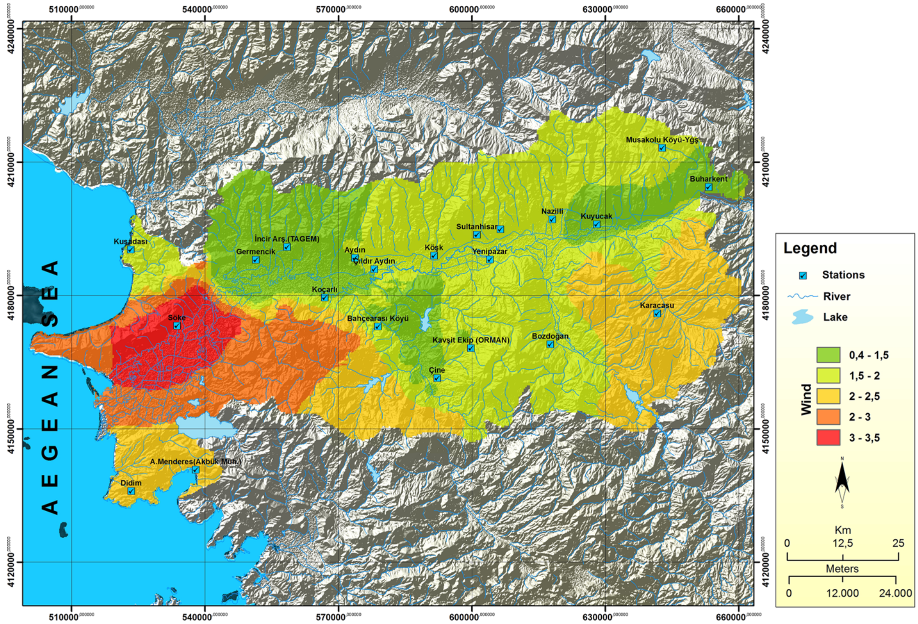

Fig. 7 Research areas' wind values

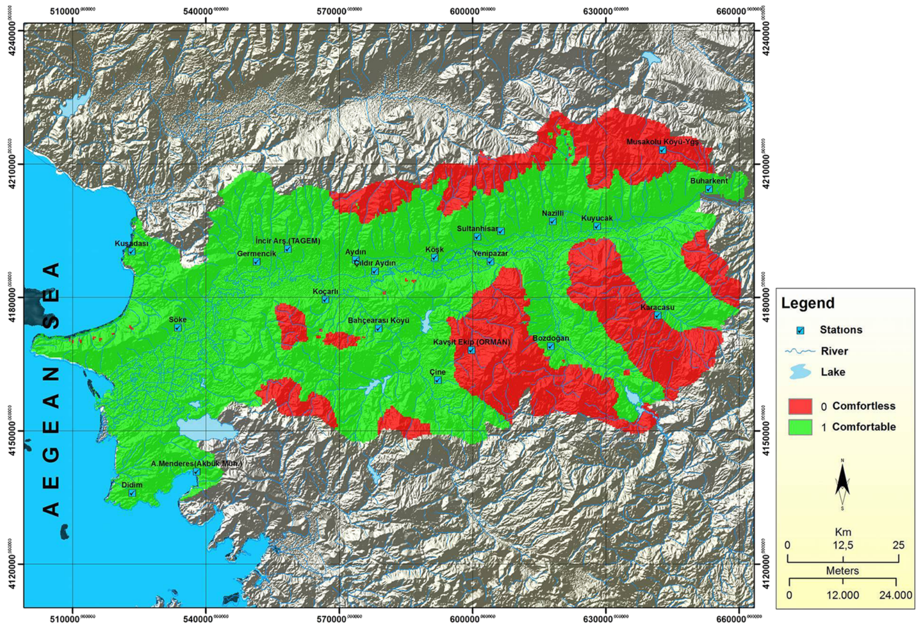

Fig. 8 Bioclimatic comfort areas for Aydin

When the area's average annual temperature was examined, it was determined that a range of temperatures was suitable for bioclimatic comfort. When the humidity and relative humidity values were examined, it was found that the areas in the north and north-

Table 1 Data from 1960 to 2015, taken from 22 meteorological stations in Aydin

Station number	Station name	Coordinates	Altitude (m)	Years	Locations
1	A.MENDERES (AKBÜK MUH.)	27°25′37,657″E 37°24′49,459″N	64	1960–2015	DİDİM
2	ATÇA BELDESİ	28°12′35,891″E 37°53′43,657″N	112	1960–2015	SULTANHİSAR
3	AYDIN	27°50′17,573″E 37°50′27,066″N	56	1960–2015	MERKEZ
4	BAHÇEARASI KÖYÜ	27°53′38,747″E 37°41′57,386″N	89	1960–2015	ÇİNE
5	BOZDOĞAN	28°20′13,875″E 37°39′39,472″N	142	1960–2015	BOZDOĞAN
6	BUHARKENT	28°44′49,422″E 37°58′20,826″N	211	1960–2015	BUHARKENT
7	ÇILDIR AYDIN	27°53′10,222″E 37°48′57,18″N	28	1960–2015	MERKEZ
8	ÇİNE	27°53′40,588″E 37°41′58,242″N	64	1964–1991	ÇİNE
9	DİDİM	27°15′31,737″E 37°21′54,711″N	35	1996–2015	DİDİM
10	GERMENCİK	27°35′20,278″E 37°50′27,923″N	28	1985–1995	GERMENCİK
11	İNCİR ARŞ.(TAGEM)	27°39′55,677″E 37°51′59,58″N	45	1960–2015	İNCİRLİOVA
12	KARACASU	28°36′30,877″E 37°43′12,824″N	583	1977–1999	KARACASU
13	KAVŞİT EKİP (ORMAN)	28°7′59,379″E 37°39′21,54″N	723	1960–2015	ÇİNE
14	KOÇARLI	27°45′29,753″E 37°45′28,967″N	30	1960–2015	KOÇARLI
15	KÖŞK	28°2′19,692″E 37°50′37,345″N	57	1960–2015	KÖŞK
16	KUŞADASI	27°15′57,864 E 37°51′42,019″N	22	1960–2015	KUŞADASI
17	KUYUCAK	28°27′10,657″E 37°53′55,279″N	72	1985–2010	KUYUCAK
18	MUSAKOLU KÖYÜ-YĞŞ	28°37′29,598″E 38°3′43,71″N	871	1960–2015	KUYUCAK
19	NAZİLLİ	28°20′43,171″E 37°54′59,467″N	84	1960–2015	NAZİLLI
20	SÖKE	27°22′40,04″E 37°42′26,082″N	11	2007–2015	SÖKE
21	SULTANHİSAR	28°9′4181″E 37°53′16,674″N	73	1972–2015	SULTANHİSAR
22	YENİPAZAR	28°11′2393″E 37°49′56,228″N	47	1960–2015	YENİPAZAR

eastern sections were determined to fit reasonably within the bioclimatic comfort range, but the remainder of the province showed results over 70%. When the wind speed was examined, it was determined that the average value of the whole area met the conditions for bioclimatic comfort.

Next, the average values of the required annual climatic comfort levels for bioclimatic building in the Aydin Province were superimposed. It was determined that, based on the results obtained from the superimposed conditions, the Aydin Province, and the area within the boundaries of its settlements, have appropriate climate values for human comfort. The necessary values to be considered comfortable in the area were determined to be 21–27 °C temperature, 30–35% relative humidity, and 0–5 m/s wind speed. The Aydin Province and settlement boundaries were observed to meet these values.

It should be noted that the bioclimatic comfort values of the settlement areas are very important for the region in terms of evaluating human health and providing comfort, considering the fact that planning activities for future residential areas in the province will need to be undertaken.

Using the study maps of bioclimatic comfort, the degree of comfort can be classified for each month of the year. The map coincides with the average annual value of the temperatures obtained for bioclimatic comfort conditions over the space of 12 months. The 12-month values were evaluated using the ArcGIS raster data functionality. In this case, each cell gives the average value for each 12 months of screening values. The map is divided into intervals based on the annual sensed temperature, appropriate or inappropriate bioclimatic comfort areas are shown on the map; and comfort zone is specified in the appropriate fields.

The correct wind temperature and humidity for the suitable comfort area of Aydin Province as defined in research were the data previously marked on the maps created with GIS software. The values used for each element in the bioclimatic comfort zone were determined by the following ranges. Overall, the analysis of the Aydin bioclimatic map indicates the most suitable areas for the relative humidity, wind, and temperature, given in Fig. 8.

The bioclimatic comfort conditions of the residential area indicate the need for a further reduction in temperature. The Aydin bioclimatic comfort range indicates that there is comfort in the 14–19 °C range. In addition, the humidity comfort range values based on the GIS map of the coastline result in a determination that the Aydin districts to the northwest of the city and the areas outside the part of west and the part of south have the appropriate ranges for comfort. Here, a suitable area for bioclimatic comfort is determined to be present.

In terms of bioclimatic comfort value, the Aydin climate map is as detailed in the above-mentioned regions. Aydin is considered as an example in terms of comfort, based on the results obtained from a large amount of data and presented on the bioclimatic map. The 7943 km^2 of total area that is suitable for Aydin bioclimatic comfort contrasts with the 3670 km^2 of areas with negative bioclimatic comfort values, which are mostly located in the northeastern part of the province. Total area bioclimatic comfort, the county has determined that it is appropriate to 3670 km^2. The reason for this is the existence of an ideal relative humidity values for bioclimatic comfort in the region.

Landscape architecture and planning in order to determine bioclimatic comfort situations can be developed with the practice of the criterion and design criteria discussed herein. Planning and design using the wrong conditions for bioclimatic comfort can create extremely unfavorable conditions, because the natural vegetation will be subject to hot or cold stress, which may be intense in areas where the natural conditions are not sufficient to provide for bioclimatic comfort. In our country, most of the energy loss encountered in creation of new zoning plans can be determined.

The results of testing for suitable bioclimatic comfort zones in the Aydin coastal areas have been presented. The data obtained in this study may be useful for the province's future planning activities. Using bioclimatic comfort as a means to ensure that regional planning structures in Aydin will maintain the highest level of comfortable climatic conditions will help in determining the limits of housing a comfortable population.

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