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The Relationship between Tourism Planning and Bioclimatic Comfort in Rural Areas: The Case of Kofçaz/Kirklareli/Türkiye

Oğuz Ateş[1,a,*], Tuğba Kiper[2,b], Osman Uzun[3,c]

[1]*Departmant of Landscape Architecture, Faculty of Architecture, Kırklareli University, 39100 Kırklareli, Türkiye*
[2]*Tekirdağ Namık Kemal University, Faculty of Fine Arts, Department of Landscape Architecture, 59030, Tekirdağ, Türkiye*
[3]*Düzce University, Faculty of Forestry, Department of Landscape Architecture, Düzce, Türkiye*
[*]*Corresponding author*

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A B S T R A C T

In this study, the bioclimatic comfort status for tourism was determined through PET using RayMan model in the case of rural settlements of Kırklareli/Kofçaz located in the northwest part of Turkey. For calculating the thermal comfort index of PET in RayMan, monthly average temperature, relative humidity, and wind measurement long- term values between 1980-2018 with respect to 13 climate stations located within the borders of Turkey and Bulgaria were used and interpolated with the IDW method in ArcGIS program. Afterwards, seasonal, and monthly climatic maps were established regarding annual average temperature, relative humidity and wind speed. The maps obtained were classified according to the comfort zones that determine the bioclimatic comfort and the bioclimatic comfort map of the study area was created. As a result of the assessments performed, it has been determined that the bioclimatic comfort situation varies temporally and spatially. The results obtained from the study will be effective in determining the period and place preferences in tourism planning, determining rural development-oriented strategies, and ensuring the quality of life and comfort of the relevant stakeholders. It will serve as a reference for the climate-sensitive approach targeted in upper-scale plans and policies within the scope of combating climate change.

[a] oguzates@klu.edu.tr https://orcid.org/0000-0002-5395-0355
[b] tkiper@nku.edu.tr https://orcid.org/0000-0003-3396-5661
[c] osmanuzun@duzce.edu.tr https://orcid.org/0000-0002-7588-9524

Introduction

Climate has a significant role in the development of many areas such as location selection, vegetation, land uses, wildlife, transportation. Furthermore, the climate has an impact on the formation, facade, orientation, construction technique, material choice and layout of the dwellings in rural areas (Çınar, 2014). In fact, according to Mandal (2001), fertile soil, moderate climatic conditions and land formation are significant when the choice of settlement is concerned. At the same time, as Bell (1999) stated, climate has a defining impact on the identity of the settlement by providing distinctive features for each settlement (Erdem, 2012). Therefore, the climate factor, which is significant in the development of rural identity defined as the form of construction, plant diversity, presence of wildlife, settlement pattern and local distinctive features, constitutes a critical attraction for tourism activities. According to Javan and Malazadeh (2013), climate is effective in determining the attractiveness of a destination, either in absolute or relative terms. Climate is a main component of nature that, in addition to being a valuable resource, determines the possibility of development of tourism. Climate has a key impact on the tourism industry by influencing the choice of destination (Abbasnia and Toros, 2019) as the main reason for touristic travels (Smith, 1993; Boniface and Cooper, 1994; Perry, 1997; Güçlü, 2010; Öztürk and Kalaycı, 2018) and affects the length, quality of tourism season as well as the environmental resources (Scott et al., 2004). Many studies have emphasized the significance of weather and climate in the context of tourism (Matzarakis et al. 2001; Matzarakis et al., 2004, Matzarakis 2007; Scott et al. 2006; Amelung et al., 2007; UNWTO 2007). Therefore, climate plays a leading role in determining the attraction values for tourism, tourism type and activities while ensuring the integration of different usage types into tourism and establishing the priorities for site selection. However, weather and climate are the dominant factors in tourist demand, and they are effective in determining the choice of destination for tourism and the type of activities to be carried out (Kakvan, et al., 2020). Therefore, having favorable climatic conditions is one of the potential advantages and potentials for tourism, and most travelers pay attention to weather conditions when choosing a destination and the time of the journey (Javan and Malazadeh, 2013). In the studies conducted with respect to tourism, the climate is addressed within the framework of bioclimatic comfort.

In tourism plans, bioclimatic comfort is effective in determining the time and space limitations for tourism (Ramadan Gourbi, 2010; Gourabi and Palıc, 2012), the length and quality of tourism seasons (Scott et al., 2004). In the national upper scale plans, it is aimed that development strategies and spatial planning decisions for tourism planning should be established within the framework of environmentally sensitive approaches (Anonim, 2017). Due to the abovementioned reasons, the recognition of bioclimatic comfort in geographical areas is important for tourism planning (Matzarakis, 2007; Kovács et al., 2017). Bioclimatic comfort provides valuable inputs for recreation and tourism planning in urban and rural areas. As Çetin et al. (2018) also stated; the bioclimatic comfort maps created may provide significant clues in determining the most appropriate destinations for recreation and residential areas. In this context, as Lopes et al. (2021) mentioned, the climatic comfort should be associated with tourism planning and management. In this regard, many scientific studies have been conducted to establish the relationship between climatic comfort and tourism for different areas. In said studies, the assessment of bioclimatic comfort conditions was realized by determining some threshold values and indices (Table 1). In such studies, within the framework of the impact of tourism on bioclimatic comfort, various predictions have been developed by making bioclimatic comfort status determinations in cases of diverse areaa using different threshold values. Generally, bioclimatic comfort conditions were determined by using PET Index values in urban and coastal areas. In this context, studies on rural areas have been very limited.

In this study, based on the aforementioned reasons, it is aimed to determine the bioclimatic comfort status for rural settlements of Kırklareli/Kofçaz in terms of tourism planning based on temperature, relative humidity and wind speed data within the framework of the hypothesis set as "determination of bioclimatic comfort areas is important in tourism planning". This study, in which the tourism planning studies to be carried out for rural areas, the bioclimatic comfort status was determined by using the PET index with the climatic data obtained from the meteorology stations of two different countries (Turkey-Bulgaria), it is important in terms of being a reference for the climate sensitive approach targeted in the upper scale plans and policies within the scope of combating climate change.

Material and methods

The main setup of the study consists of determining the bioclimatic comfort conditions for tourism planning in the case of Kofçaz rural settlements in Kırklareli/ Turkey. The study area is located at the foothill of the Yıldız (Istranca) Mountains in the northwest direction of Turkey, with Bulgaria in the north, Kırklareli in the south and Edirne province in the southwest. It borders with Bulgaria and is 235 km away from Istanbul. The total research area is 530 km² and there are 2 neighborhoods and 16 villages connected to the district (Figure 1).

Table 1. Studies involving the relationship between climatic comfort and tourism and the threshold values used

Main Purpose: To find the temperature values felt in the work area by using the temperature, wind, and relative humidity data and to determine the comfort zones where people feel comfortable, comfortable and healthy according to these values.

Reference	Study area	Thermal Comfort analysis (parameters and indexes)
Matzarakis, 2006	Santorini/Greece	PET
Lin and Matzarakis, 2008	Sun Moon Lake, Taiwan	PET
Gaurabi and Palic 2012	Caspıan Sea/ Iran	TCI
Mansouri Daneshvar et al. 2013	Iran	PET
Lindner-Cendrowska, 2013	Warsaw/ Poland	UTCI, PET
Esmaili and Ghalh 2014	İran	PET
Farzanej et al. 2014	Dezful/Iran	TCI, THI
Rutty and Scoot 2014	Caribbean beaches in the islands	UTCI
Katerusha and Matzarakis 2015	Odessa/Ukraine	CTIS, PET
Özşahin et al., 2015	Artvin/Turkey	SET*, PET, PMV, TCI, THI, SSI
Akbarian Ronizi et al., 2016	Northern coast of Iran	PET
Kovacs ´ et al. 2016	Szeged/ Hungary	CTIS, PET, TCI, TPV, TSV,
Hanafi and Atashgahi, 2017	North West of Iran	PET
Roshan et al. 2018	Iran	PET, UTCI
Mihăilă et al., 2019	Romania	PET
Abdulrahman Hamad and Oğuz, 2020	Erbil – Iraq	PET
Shang et al., 2020	Haikou/ China	PET
Hama Sharef and Oguz, 2020	Sulaimani – Iraq.	PET
Lopes et al., 2021	Porto (Portugal)	PET, TSV, TPV

PET: Physiological Equivalent Temperature; PMV: Predicted Mean Vote, SET*: New Standard Effective Temperature; SSI: Summer Simmer Index, TCI: Tourism Comfort Index, THI: Thermo Hygrometric Index, TPV: Thermal Preference Vote; TSV: Thermal Sensation Vote; UTCI: Universal Thermal Comfort

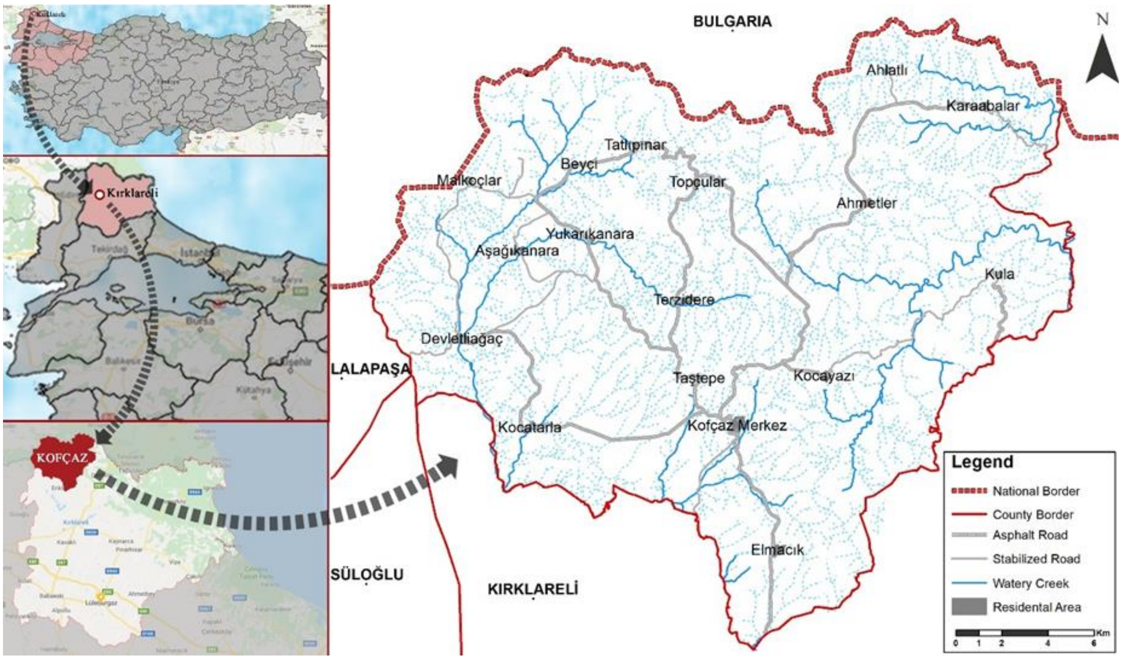

Figure 1. Location of study area

Table 2. Mean monthly temperatures, humidity and wind speed, values of all stations (1980-2018) in Kırklareli, Turkey and Bulgaria.

SN	V	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann.
Ahtopol/ Bulgaristan	T (°C)	7.0	7.0	7.0	11.0	17.0	21.0	25.0	26.0	23.0	19.0	11.0	9.0	10.7
	H (%)	77.0	75.0	79.0	77.0	75.0	76.0	70.0	67.0	69.0	69.0	77.0	83.0	74.5
	W (s/m)	4.1	3.9	3.5	2.7	2.7	2.6	3.2	2.8	3.7	2.7	3.6	3.4	3.2
Alpullu/ 9,034	T (°C)	4.1	4.4	6.7	12.2	16.9	22.0	23.7	23.2	20.6	14.3	8.5	7.0	13.6
	H (%)	82.1	78.0	76.3	71.2	68.7	64.1	61.7	63.7	65.6	72.9	78.3	81.6	72.0
	W (s/m)	1.4	1.6	1.6	1.6	1.3	1.3	1.3	1.4	1.3	1.2	1.1	1.4	1.4
Babaeski/ 18,405	T (°C)	3.5	7.1	9.3	13.2	18.0	22.1	24.6	25.4	20.8	14.5	10.5	5.2	14.5
	H (%)	88.2	82.8	82.1	71.7	72.6	69.7	64.5	61.6	66.2	80.4	84.2	87.0	75.9
	W (s/m)	3.0	3.8	3.2	2.8	3.0	2.9	2.9	3.4	3.1	3.0	3.0	2.8	3.1
Burgas/ Bulgaristan	T (°C)	6.0	7.0	7.0	11.0	17.0	21.0	26.0	27.0	23.0	19.0	10.0	9.0	15.3
	H (%)	78.0	74.0	78.0	78.0	77.0	75.0	64.0	62.0	63.0	66.0	71.0	82.0	75.8
	W (s/m)	3.8	3.6	3.6	2.9	2.9	2.7	3.6	3.4	4.0	2.8	3.1	3.4	3.3
Demirköy/ 18,102	T (°C)	3.5	5.6	8.1	12.8	16.8	20.1	22.2	22.9	18.8	13.3	9.8	4.7	13.2
	H (%)	81.6	82.8	75.2	64.1	70.9	72.8	70.8	70.3	73.8	80.0	83.5	77.0	75.2
	W (s/m)	2.3	2.3	2.2	2.1	2.0	2.1	2.1	2.0	2.0	1.9	1.8	2.3	2.1
Demirköy/ Beğendik/ 18,795	T (°C)	3.1	6.5	8.1	10.7	16.5	21.1	22.9	24.2	20.4	15.6	10.6	5.3	13.8
	H (%)	83.5	83.1	83.1	81.5	86.4	85.5	84.5	82.2	82.4	85.7	87.4	81.1	83.9
	W (s/m)	3.2	3.6	2.7	2.3	2.5	2.3	2.4	3.4	3.1	3.0	3.1	3.2	2.9
Elhovo/ Bulgaristan	T (°C)	5.0	7.0	7.0	11.0	18.0	22.0	28.0	30.0	25.0	19.0	9.0	8.0	14.4
	H (%)	78.0	75.0	75.0	75.0	74.0	72.0	51.0	49.0	52.0	62.0	70.0	84.0	73.0
	W (s/m)	2.8	2.7	3.0	2.4	2.2	2.0	3.1	2.9	3.1	2.2	1.9	2.8	2.6
Kırklareli/ 17,052	T (°C)	3.1	4.1	7.1	12.3	17.3	21.7	24.3	24.1	19.7	14.2	9.0	4.9	13.5
	H (%)	78.9	75.5	72.2	66.4	64.4	62.0	58.6	59.3	64.0	72.8	77.5	79.1	69.2
	W (s/m)	1.6	1.7	1.7	1.6	1.4	1.3	1.3	1.3	1.3	1.3	1.4	1.6	1.5
Kofçaz/ 18.406	T (°C)	2.4	4.9	7.5	12.3	16.2	20.1	22.7	23.1	19.1	12.6	9.5	4.6	12.9
	H (%)	78.7	77.5	71.6	63.5	63.4	64.5	58.5	57.7	63.8	74.4	79.4	80.6	69.5
	W (s/m)	3.2	3.9	3.6	3.0	3.0	2.8	2.7	3.6	3.3	3.2	3.3	3.2	3.2
Lüleburg. Tigem/ 17,631	T (°C)	3.4	4.5	7.4	12.0	17.0	21.6	23.9	23.7	19.6	14.3	9.0	5.1	13.5
	H (%)	80.6	76.5	74.7	71.3	68.1	64.5	61.8	61.7	65.8	72.8	78.4	80.9	71.4
	W (s/m)	1.4	1.8	1.8	1.5	1.4	1.3	1.4	1.5	1.4	1.3	1.3	1.5	1.5
Pehlivanköy 18407	T (°C)	3.3	7.1	9.3	13.1	18.0	22.1	24.4	24.9	20.5	14.3	10.7	5.1	14.4
	H (%)	73.2	84.1	87.7	81.3	78.4	76.5	57.0	49.4	65.0	72.6	67.0	72.3	72.0
	W (s/m)	3.1	3.8	3.2	2.7	2.7	2.7	2.6	3.1	2.7	2.8	2.9	2.9	2.9
Pınarhisar 18398	T (°C)	4.4	5.1	4.5	3.7	4.1	4.6	4.6	5.5	4.9	4.7	4.5	4.3	4.6
	H (%)	85.3	87.7	84.0	67.9	73.6	68.3	64.0	63.7	67.2	78.5	81.8	80.2	75.2
	W (s/m)	3.0	6.2	8.6	13.1	17.3	21.4	23.7	24.4	20.6	14.3	10.3	5.1	14.0
Vize/ Kıyıköy 18103	T (°C)	4.9	7.0	8.7	11.9	16.9	21.0	23.1	24.2	20.1	14.9	11.5	6.2	14.2
	H (%)	85.3	85.5	81.7	78.5	81.1	80.5	79.2	79.1	80.0	82.8	85.4	83.0	81.8
	W (s/m)	1.7	2.0	1.7	1.6	1.5	1.5	1.6	1.8	1.6	1.8	1.6	1.7	1.7

SN: Station Name/ Number; V: values; Ann: Annual

There are forest lands in a large part of the district (a size of 30866 ha and a rate of 64.12%). It has been proposed as an eco-agro tourism area in the upper scale plans (Anonymous, 2009; Anonymous, 2012; Anonymous, 2014) and has a significant potential in terms of natural, historical, archaeological, and cultural landscape values. In the area defined as "Eco-agro tourism area" in the upper scale plans, however the tourism activities are not concentrated yet, the determination of bioclimatic comfort zones will form an important base for tourism planning.

For this purpose, long-term average air temperature, relative humidity, and wind speed data for the years 1980-2018 from 10 (MGM, 2019) meteorology stations located in the province of Kırklareli and from 3 meteorology stations located (World Weather Online, 2021) within the borders of Bulgaria (Table 2) has been used.

For bioclimatic comfort analysis, PET index was used through Rayman model. The RayMan model, developed according to Guideline 3787 of the German Association of Engineers calculates estimates the radiation fluxes and the effects of clouds and solid obstacleson short wave radiation fluxes (Matzarakis and Rutz, 2005; Matzarakis, et al., 2007; Daneshvaer et al. 2013). PET is one of the most common indexes used to determine the appropriateness of bioclimatic comfort in tourism. The PET index is appropriate to evaluate the bioclimatic conditions in different geographical regions (Gulyas, 2005; Matzarakis et al., 2013). PET reflects weather conditions better than other indexes (Farajzadeh and Matzarakis 2012) or other methods. Compared to other thermal indices PET offers the advantage of a widely known unit (degrees Celsius), which makes results more easily understandable for regional or tourism planners, who may be not so familiar with human bio–meteorological terminology (Matzarakis et al., 1999 Bulgan and Yılmaz, 2017). The PET method emerged as a simplification of the "Munich Energy Balance Model for Individuals" (MEMI) (Höppe 1999). Mean radiant temperature Tmrt (°C) is one of the most significant determining factors of the PET method (Herrmann and Matzarakis 2012, Chen and Matzarakis 2014). Other significant meteorological input parameters for PET are wind speed v (m/s) and air temperature Ta (◦C). Humidity in the air (VP (hPa), as well as relative humidity RH (%)) has a very weak impact on PET (Chen and Matzarakis 2014, Fröhlich and Matzarakis 2016). In this study, the coordinates and altitudes of each meteorology station were entered into the RayMan program in order to obtain the PET value (Figure 2), then, the calculations were made by entering the meteorological data.

The PET value obtained through the calculations (Figure 3) was entered into the database of each meteorology station in the ArcGIS program. The calculated PET values referred to a person who is 1.75 m, 75 kg, and 35 years old standing male in the sun (VDI, 1998).

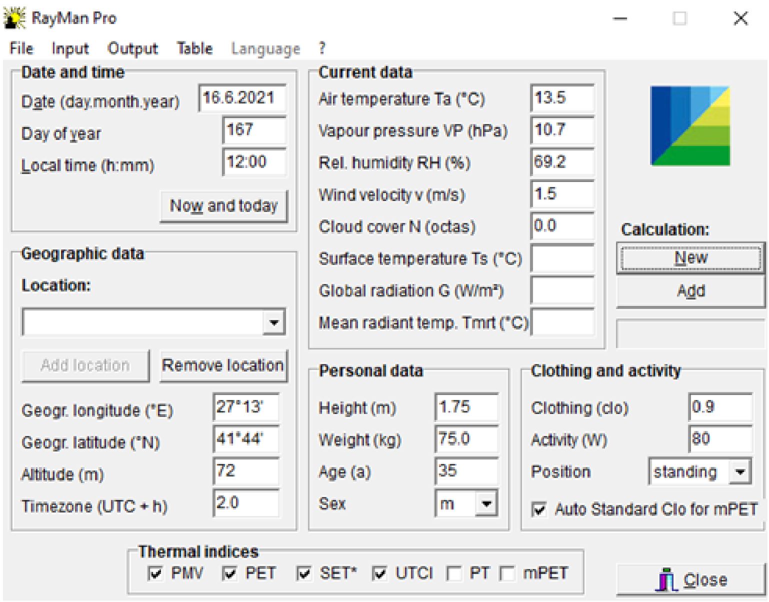

Figure 2. Graphical user interface of Rayman model

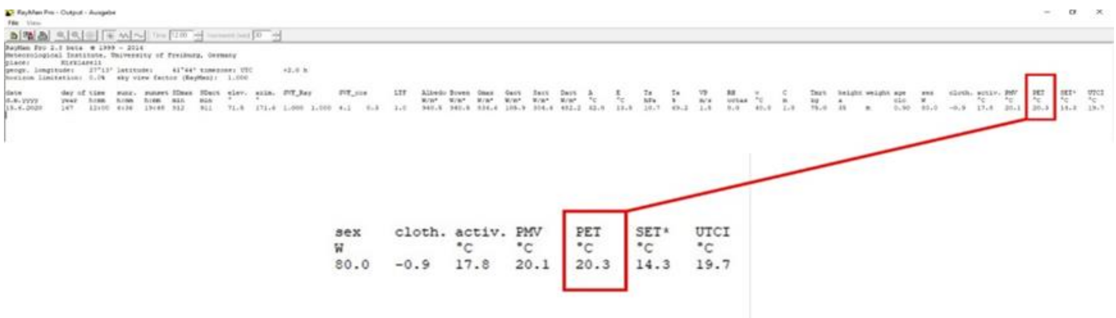

Figure 3. PET value after analysis with RayMan Pro program

Table 3. Physiologically Equivalent Temperature (PET) for different grades of thermal sensation and physiological stress on human beings (Matzarakis and Mayer, 1996)

PET (°C)	Thermal sensation	Physiological stress level
>41	very hot	extreme heat stress
35 – 41	hot	strong heat stress
29 – 35	warm	moderate heat stress
23 – 29	slightly warm	slight heat stress
18 – 23	comfortable	no thermal stress
13 – 18	slightly cool	slight cold stress
8 – 13	cool	moderate cold stress
4 – 8	cold	strong cold stress
≤4	very cold	extreme cold stress

The PET temperature values obtained and processed into the meteorology stations database were interpolated with the Inverse Distance Weighted (IDW) method in ArcGIS program and seasonal and monthly climate (average temperature, relative humidity, and wind) maps were created.

The Inverse Distance Weighted (IDW) interpolation method is a frequently used method for multivariate interpolation of a known scattered point set. Values assigned to unknown points are calculated as a weighted average of the values available at known points. IDW indicates that there is a strong relationship between variables locally and this relationship is the sum of the inverse powers of the distance between points with known values and the point to be estimated (Liu et al., 2021). The mathematical expression of IDW is as follows:

$$\hat{z} = \frac{\sum_{i=1}^{n} \frac{Z_i}{d_i^n}}{\sum_{i=1}^{n} \frac{1}{d_i^n}}$$

here zˆ is the attribute value of the point to be predicted, Zi is the attribute value of the individual observation point, di is the Euclidean distance between the predicted point and the observation point, and n is the exponential power exponent (Liu et al., 2021).

The higher the power, the smaller the effect of the point estimated from the far reference point and the smoother the final interpolation result. The Inverse Distance Weighted (IDW) interpolation method assumes that the objects to be predicted are uniformly distributed in space. Therefore, the Inverse Distance Weighted (IDW) interpolation method gives better results when working with objects with different values in each area (Liu et al., 2021).

The PET values obtained were classified according to the comfort zones that determine the bioclimatic comfort provided in Table 3.

Results and discussion

Seasonal and Monthly and Temperature Results

Seasonal and monthly temperature maps were created by interpolating with the Inverse Distance Weighted (IDW) method. Accordingly, the average temperatures in winter months (December, January, and February) vary between 2.5°C and 6.00°C. In December and February, the temperatures in the south, especially in the parts close to the Bulgarian border, vary by 5.00-6.00°C, while the lowest temperatures are observed during the year with 2.00-4.00°C in January. In the spring season, which includes the months of March, April and May, the average temperatures vary between 7.17°C and 17.00°C. The lowest temperatures in the spring season are observed in March with the range of 7.17°C-7.53°C in the entire study area. In May, temperatures in the south of the study area, especially in the parts close to the Bulgarian border, vary between 16.51°C and 17.00°C. Although it varies between 20.4°C and 24.5°C in June, July, and August, which includes the summer period, generally lower temperatures were observed in the northern parts. Higher temperatures are observed in the eastern and western parts of the study area. In autumn (September-October-November), temperatures vary between 9.00°C and-21.00°C. While the lowest temperatures such as 9.00°C are observed in the northwest, south and west parts of the area in November, the highest temperatures are observed at 20.5°C in the northwest and northeast parts of Malkoçlar settlement. Considering the general assessment, the highest temperature was observed in August with 24.5°C, and the lowest temperature was observed in January with 2.5°C (Figure 4).

Seasonal and Monthly Relative Humidity Results

When seasonal and monthly relative humidity values are examined; for the winter months (December, January, and February), a variation of 80.00-87.59% was observed. The maximum variation in the relative humidity factor is seen in February. When the general situation for the winter months is examined; the humidity rate is relatively lower in the southern parts of the study area, and the highest humidity is observed in the middle sections in February with the range of 86.00-87.59%. In winter, the settlements in Kofçaz center, Terzidere, Kocayazı, Taştepe and Elmacık are relatively more humid than the general study area. While the relative humidity values (80.00-82.00%) observed in December and March are the same and the humidity is higher in the southern parts of the area in March, higher humidity is observed in the northern parts in December. Humidity decreases in May and April. The lowest humidity rate is observed in the southeastern part of the area with 65.00-66.00% in April. Humidity in summer months varies between 62.00 and 70.00%. While the highest humidity for summer months is observed in the northern and middle parts in June, the lowest humidity is seen in August with 62.00-63.00% in the parts of Aşağıpınar, Beyci and Tatlıpınar settlements. In the autumn season, which includes September-October-November, the relative humidity values vary between 65.00 and 83.00%. The highest humidity is observed in the northern and central parts of the study area in November, while the lowest humidity is observed in the western part in September. Considering the general assessment; the highest humidity was observed in February with 87.59% and the lowest humidity was observed in August with 62.00% (Figure 5).

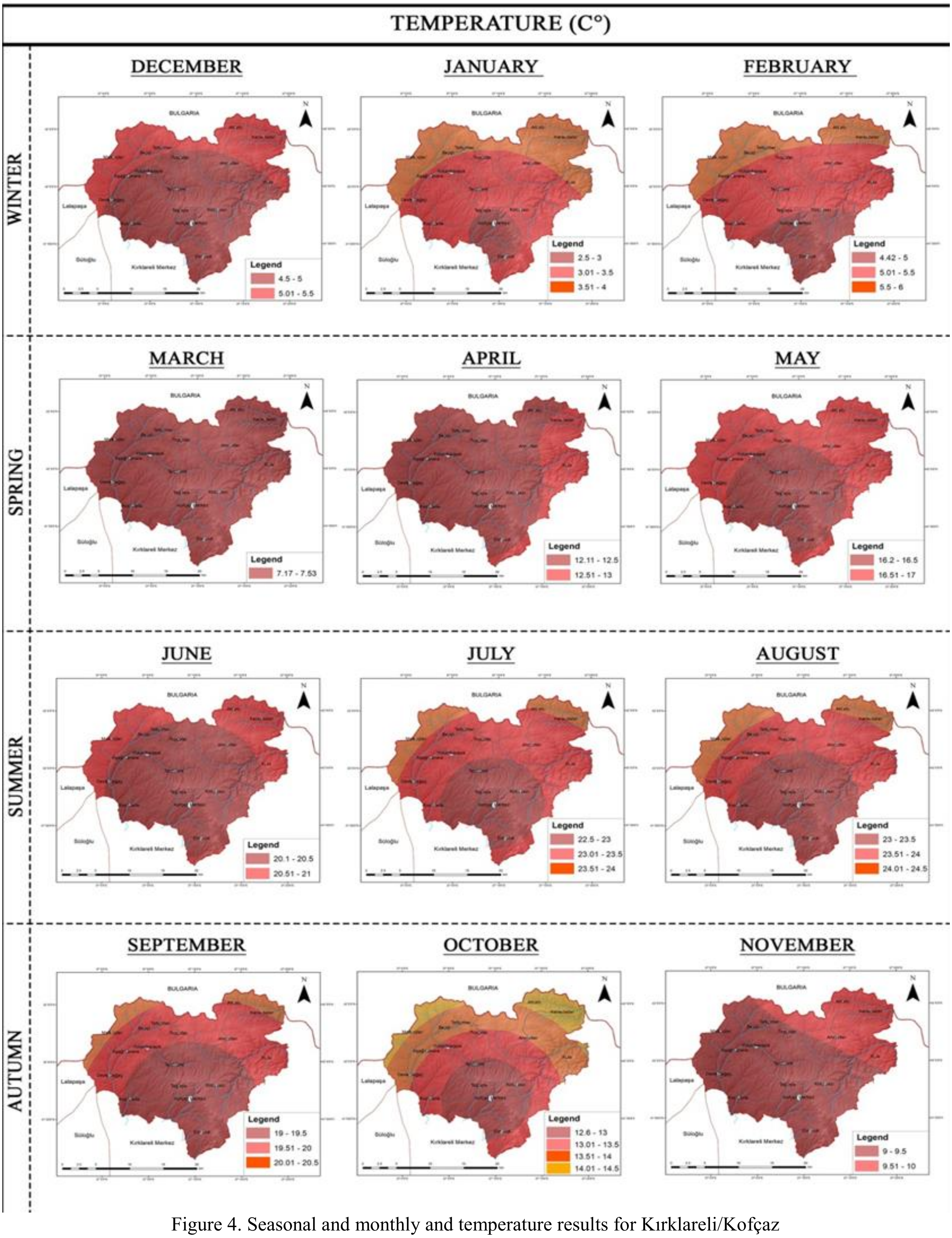

Figure 4. Seasonal and monthly and temperature results for Kırklareli/Kofçaz

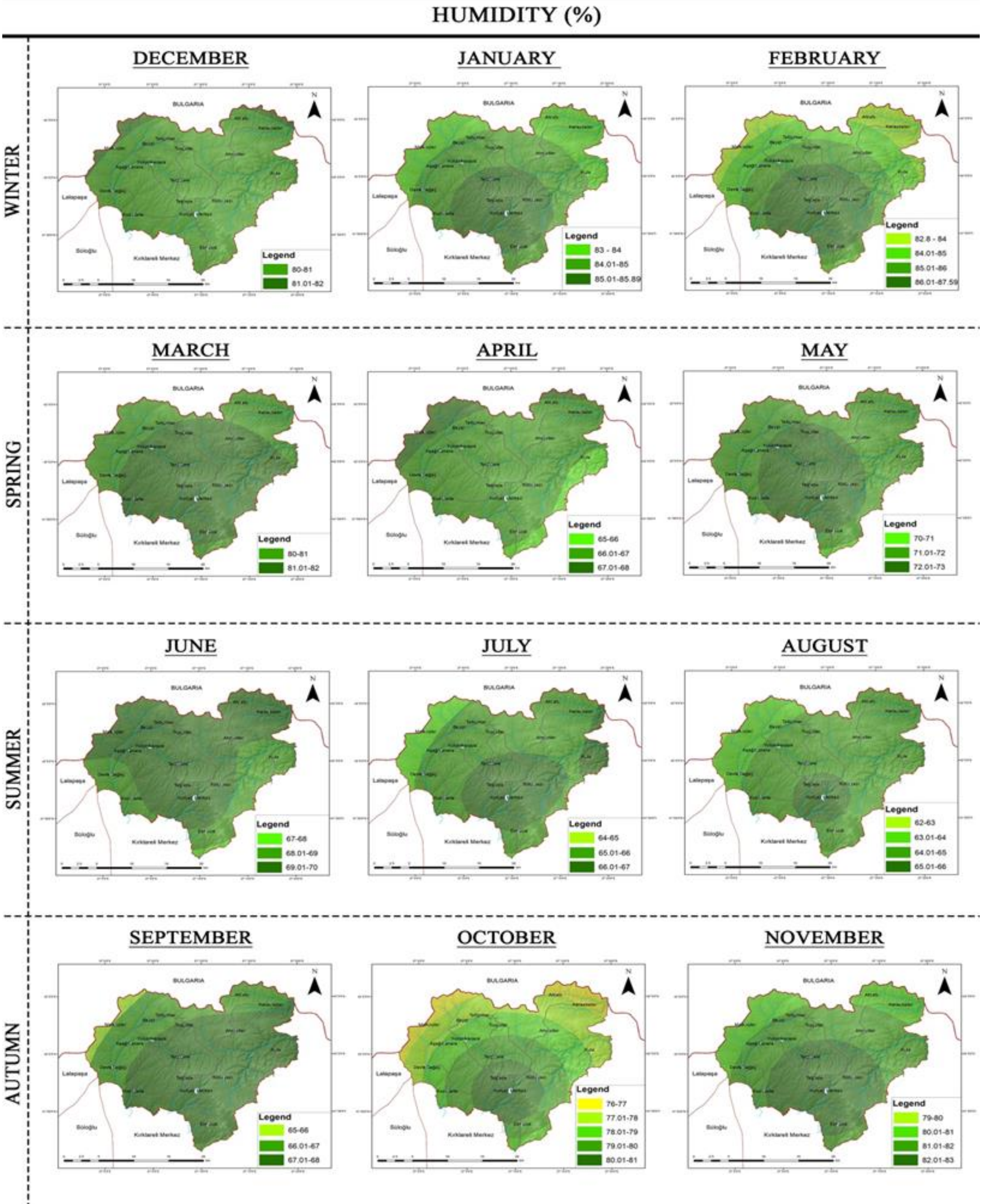

Figure 5. Seasonal and monthly relative humidity results for Kırklareli/Kofçaz

Seasonal and monthly wind results

When the wind speed values are analysed, a variation between 2.5-3.93 m/sec was observed for the winter months (December, January, and February). While the wind speed is higher in the middle parts of the field, it is relatively lower in the other parts. In February, the wind speed reached its highest value with 3.93 m/s. In the spring and summer periods, the wind speed varies between 2.00-3.6 m/s. In spring, while the wind speed is lower in the northeastern parts of the area, it is relatively higher in other parts. The highest wind speed value of 3.6 m/s is observed in Ahlatlı, Karaabalar, Kula settlements and other parts of the area except for a small part of the northwest part of the area in March and August. In the autumn period, including the months of September, October, and November; a wind speed variation between 2.5-3.57 m/s is observed. The highest wind speed is seen in November in the middle parts of the study area, where Kofçaz center, Terzidere, Kocayazı, Taştepe and Elmacık are located. Considering the general assessment, the highest wind speed was observed in February with 3.93 m/sec and the lowest wind speed was observed in April, May, June and July (Figure 6).

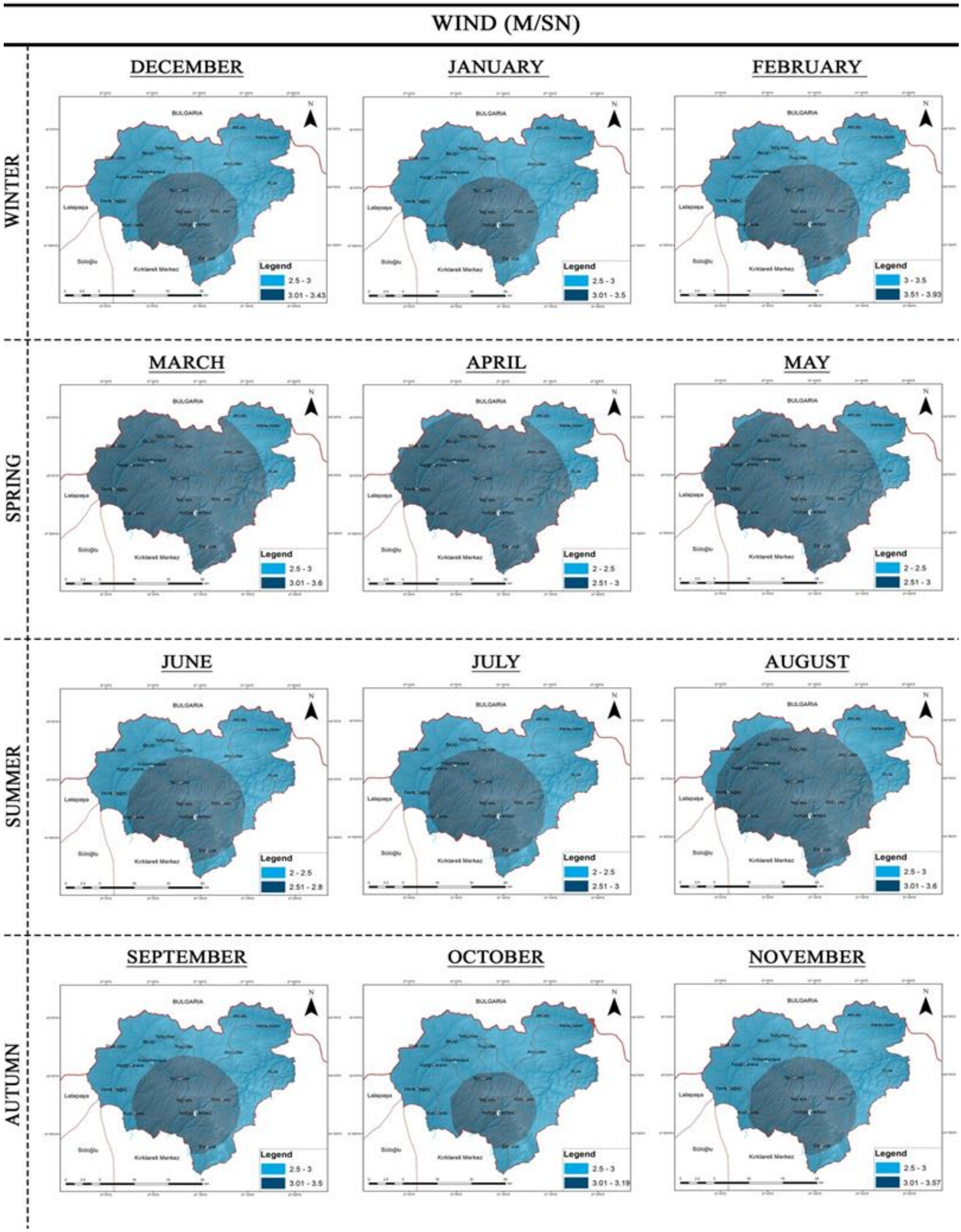

Figure 6. Seasonal and monthly wind results in Kırklareli/Kofçaz

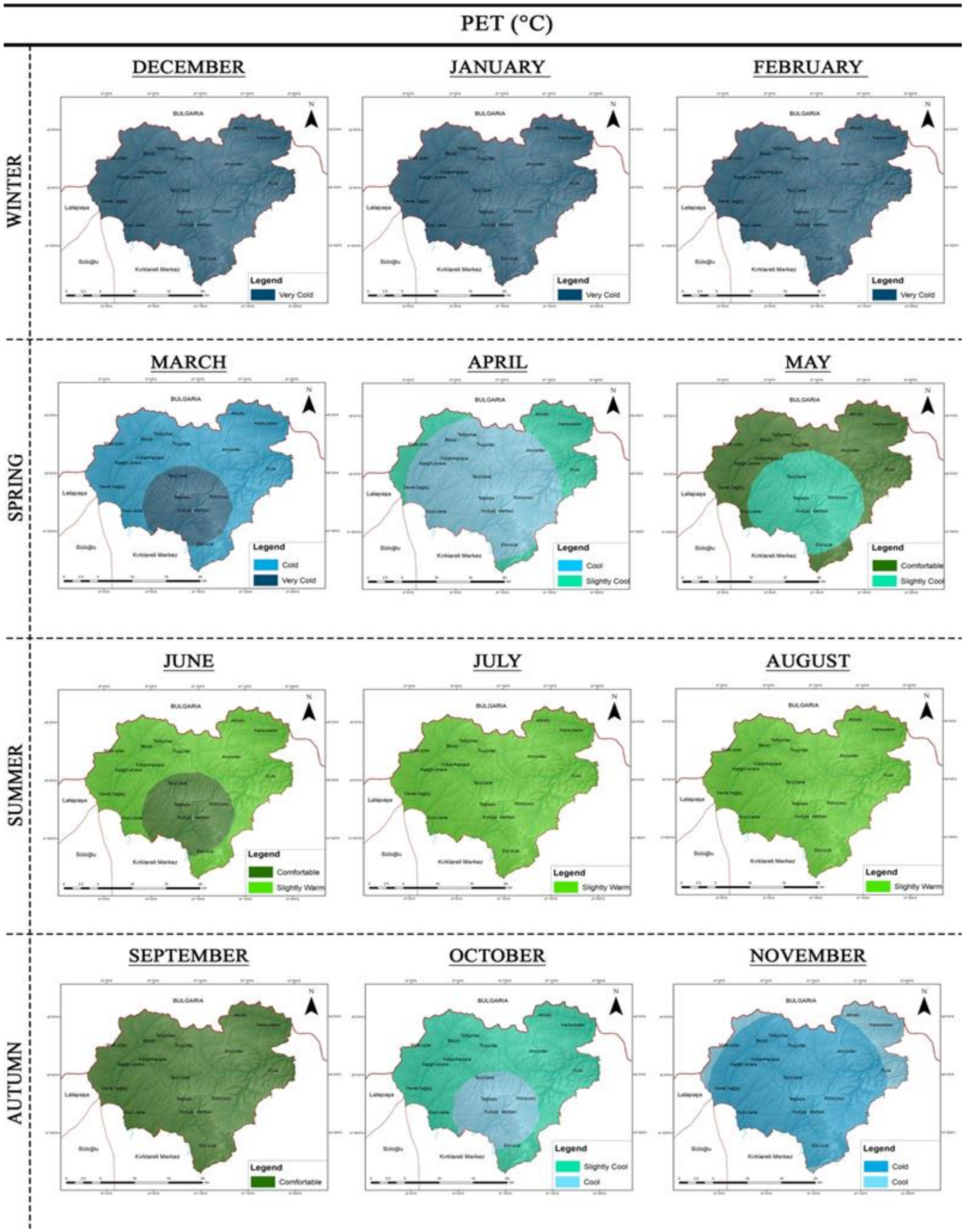

Figure 7. Seasonal and monthly values for PET in autumn

Seasonal and Monthly Values for PET

However, the monthly analysis of bioclimatic conditions has a significant difference with the annual mean of bioclimatic conditions. Average temperature, relative humidity and wind maps were classified according to the comfort zones that determine bioclimatic comfort, and seasonal and monthly comfort maps were produced. However, the monthly analysis of bioclimatic conditions has a significant difference with the annual mean of bioclimatic conditions. Accordingly, when the winter months covering December, January and February were assessed in terms of bioclimatic comfort, the whole of

Kırklareli/Kofçaz was found to be very cold. In the spring, the most appropriate month in terms of bioclimatics was determined as May, and this distribution was observed in the northern, eastern, and western parts of the area. In the summer months, while the month of June is comfortable, a slightly warm distribution was detected in July and August. In summer, the settlements where Kofçaz center, Taştepe, Terzidere, Kocayazı and Elmacık are located are the most appropriate destinations in terms of bioclimatic comfort. Considering the autumn season in terms of bioclimatic comfort, the most appropriate month is September in which all settlements are comfortable. The other two months were determined as slightly warm and cool in terms of bioclimatic comfort. In the general assessment, it was revealed that the region covering Terzidere, Kocayazı, Taştepe, Elmacık villages and Kofcaz center mostly has a colder thermal perception than other regions. Again, in the 5-month period between May and September, it was determined that the thermal perception was positive throughout Kofçaz district (Figure 7).

Discussion

In the study, the bioclimatic comfort status analysis has been conducted for the case of Kırklareli/kofçaz rural settlements in terms of tourism activities based on seasonal and monthly mean temperature, relative humidity, and wind velocity data by making use of the data acquired from 10 meteorology stations located within the provincial boundaries of Kırklareli (MGM, 2019) and 3 meteorology stations located within the boundaries of Bulgaria (World Weather Online, 2021). RayMan model has been applied for the bioclimatic comfort analysis and PET calculation has been performed. It has been identified within the framework of the calculation that the bioclimatic comfort status varied in spatial and temporal terms. This situation shall also affect the climate comfort and further affect people’s preferences for places and periods in terms of tourism and shall be a factor in mobility between locations. In fact, one of the direct substantial effects of climate on tourism is the seasonal effect (Kennedy, 1999; Baum and Landtorp, 2001; Lim and McAleer, 2001). In this context, the months of May, June and September are determined within the comfortable category representing the most suitable months for tourism activities. Nevertheless, strong cold stress conditions have been identified in the months of December, January, and February. The most suitable months the climatical comfort level for tourism and touristic activities have been identified as May, June and September in the study conducted by Mirza et al. (2020) in the case of Eğirdir/Isparta/Turkey, as June in the study conducted by Farajzadeh and Matzarakis (2009), while it has been identified as September in the study Ghavidel Rahimi Ahmedi, 2013. Maximum thermal comfort has been determined as the month of May in the study of Khoir et al. 2018. In the study of Roshan et al. (2018) it has been revealed that the months of May and September offers the most suitable thermal comfort presenting the most convenient conditions for tourism, while in the study of Mohammadi et al. (2018), cold stress conditions have been identified to be in the months of December, January, and February. In the study of Güngör et al. (2021), the months of May and September have been identified as comfortable. In the study conducted by Adiguzel et al. (2020), Fall season has been identified as the most suitable season in terms of climatic comfort and September has been the most comfortable month accordingly. In the study of Akbarian Akbarian Ronizi et al. (2016), fall season has been the most convenient season in terms of climatical comfort. This situation supports the outcomes of the study. The best conditions for recreation and tourism have been observed from the mid-April to early June and from late August to late October in the study of Katerusha ve Matzarakis (2015). The study of Özşahin et al. (2015) has identified that the most convenient conditions have been experienced in the months of April, May and September-October based on the PET index in terms of tourism activities in Artvin/Turkey.

Based on the average annual PET values of the study area, a bioclimatic comfort distribution map was prepared (Figure 8). According to this, the southern, eastern and western parts of the study area, where Aşağıkanara, Devletliağaç, Kocatarla, Elmacık, Kula, Karaabalar settlements are located, have been determined to be high in terms of bioclimatic comfort, with a rate of 60% (Figure 8, Table 4). Based on these outcomes, it has been further identified that thermal perception of district of Kofçaz is quite positive and thus, presenting a high potential in terms of tourism facilities.

When Figure 8 is reviewed, settlements close to the border with Bulgaria and central parts at the north located at the central point have been identified as slightly cold in terms of bioclimatic comfort. This situation has constituted a sharp border on the map in terms of bioclimatic comfort. The areas within the category of slightly cold have constituted a sharp border due to factors such as elevation differences, high tableland features and proximity to the border of Bulgaria relatively with colder climate structure than the conditions of Turkey. Formation of these sharp borders results from performance of analysis from interpolated 13 general stations by the method of Inverse Distance Weighted (IDW) in the software ArcGIS 10.2. It is considered that these sharp borders can be distributed in accordance with the topography of the land with the establishment of intermediate stations in the intermediate regions on the land.

Conclusion

Within the scope of the study, with the determination of the bioclimatic comfort situation for tourism, an approach considering the climatic conditions, which is targeted in the national upper scale plan decisions, has been revealed (Anonymous 2017; Anonymous, 2018; Anonymous, 2019). So much so that in the upper scale plans; it is aimed to use natural resources effectively for sustainable development purposes and to consider climatic comfort in land use decisions (Anonymous 2020). This study shall contribute to the studies conducted at different scales as presented below.

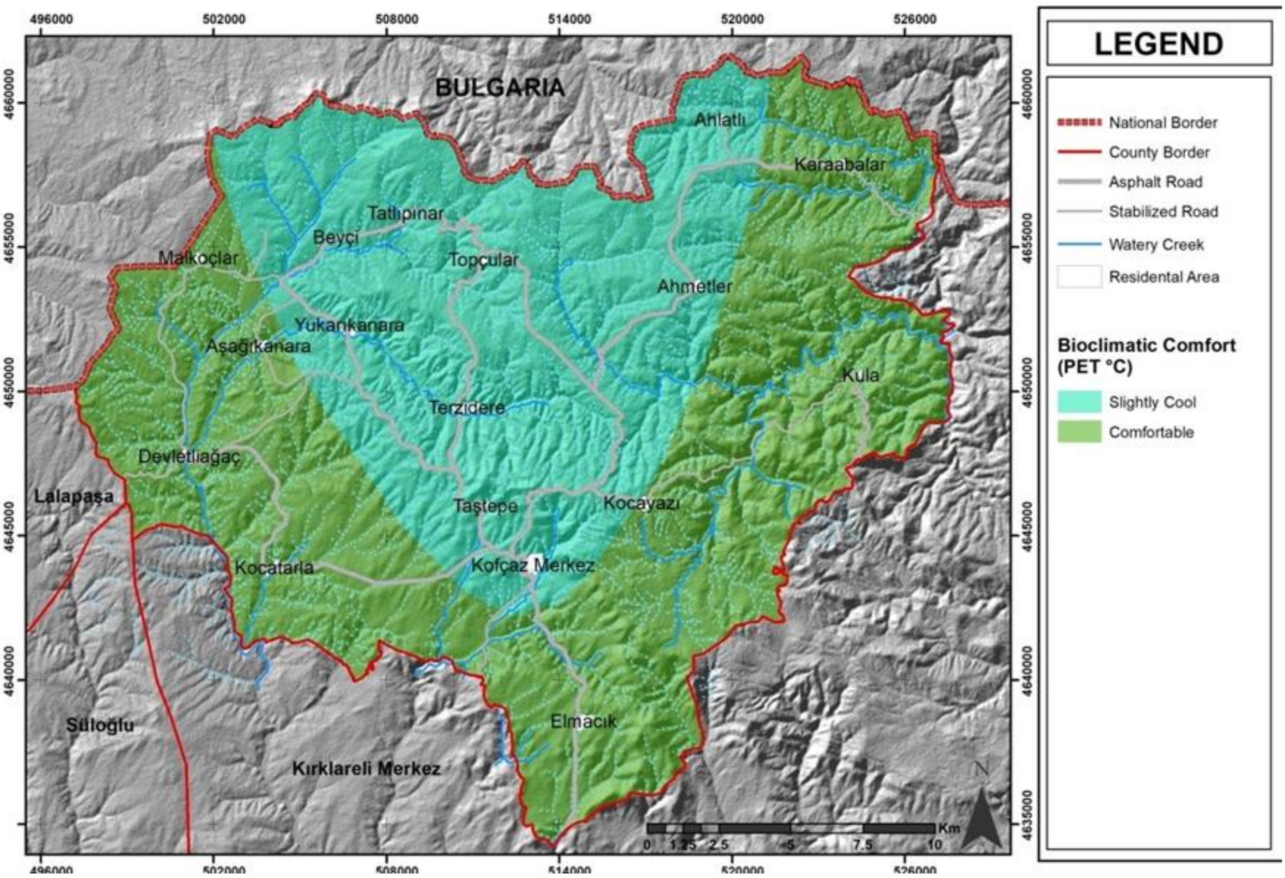

Fig. 8. Spatial distributions of PET levels based on mean annual values

Table 4. Bioclimatic comfort area distribution amount (PET levels based)

Bioclimatic comfort	Area distribution (m^2)	Percent (%)
13-18 (comfortable)	215965000	40
18-23 (slightly cool)	328773000	60

- Taking into consideration that the tourism is affected by the climate change within the scope of the combating the climate change due to global warming (Hein et al., 2009; Cheablam and Shrestha, 2015) and recreational activities trigger the climate change (Gössling vd., 2010), Studies on the determination of bioclimatic comfort zones shall contribute to reducing the effects of climate change and adapting to changes as emphasized by Mansuroğlu vd. 2021. It is recommended that the results of climate comfort studies be included in the tourism planning processes.
- As the outcomes of this study shall ensure the identification of the local climate, within the framework of the UN Global Sustainable Development Goals, it shall directly and indirectly contribute to the goals of healthy and quality life, sustainable cities and communities, responsible production and consumption, and climate action.
- As for the national upper scale planning and policy approaches, it has been taken notice of the requirement of replanning of the tourism season considering the effects of climate change (Anonymous, 2020). Bioclimatic maps shall be effective in tourism planning studies, determining period and place preferences, efficient use of resources, and ensuring the quality of life and comfort of relevant stakeholders.
- Bioclimatic findings acquired from the study shall be generalized in provincial and regional terms and can be able to be applied in the tourism planning on international level.
- Bioclimatic maps shall contribute to the planning of sub-scale ecotourism destinations in the residential sector, the determination of the periods when agrotourism-based activities shall be performed in the agriculture sector, and the seasonal planning of ecotourism activities based on forestry byproducts in the forestry sectors. The findings acquired from the study can be used to prepare an extensive tourism climate brochure.
- According to O’Donnell and Ignizio, 2012, the results of bioclimatic research are often used across a wide range of fields, such as ecology, agriculture, architecture, urban planning, tourism, health, and transportation. This situation shall provide support in societal terms by introducing positive contributions in terms of improvement of the rural quality of life of the study area.
- From an economic perspective, determining the bioclimatic comfort situation shall contribute to the prevention of heat losses by reducing energy requirements, particularly with detailed analyzes at micro levels.

As a conclusion, increase in the number of countries party to the Paris convention as of 2021 introduce certain obligations to the countries with these conventions. It has been revealed that bioclimatic comfort mapping endeavors performed within the scope of this study shall present substantial contributions to various sectors, particularly the tourism and thus, they are required to be generalized in provincial and regional scale.

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