Chapter 3

Investigation and Comparison of Climate Boundary Maps Generated with Various Climate Classifications

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Abstract

Climate has continuously undergone change throughout history. Understanding this change contributes significantly to the determination of boundaries for different climate types. Climate classifications aim to differentiate various climate types and identify similar or different locations. This facilitates the sustainable use of local resources and the development of land use plans. Additionally, comprehending the impact of climate on property is crucial for its management and regulation, enabling a more organized approach to property utilization.

In this context, various climate classification methods have been developed. These methods assist in determining local climate differences, tracking changes over time, and establishing boundaries suitable for different climate types. This study aims to create climate boundary maps for Burdur province using Köppen, Trewartha, de Martonne, Aydeniz, Erinç, and Thornthwaite methods. Within the scope of the study, data from 11 meteorological observation stations in Burdur province have been organized within a Geographic Information System (GIS) and classified into climate types. Finally, climate boundary maps representing the entire region were generated using the Kriging interpolation method based on the identified climate classification.

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1. Introduction

Processes dominant on earth are controlled by various forces, and depending on the qualities and quantities of these forces, different environments and ways of life emerge. These environments are determined by different criteria for each subject, and for climatology, they are characterized by the prevailing weather conditions. In climatology, the average character of the prevailing weather is revealed by climate classifications. Climate is defined as the combination of the average characteristics of all weather conditions observed over long periods of time in any region of the earth, along with the temporal distribution of these events, observed extreme values, severe events and all variations (Türkeş, 2010). Here, long periods of time refer to a time span of 300-500 years in geological time scales. In these geological time scales, climates are constantly changing. Climate is a factor that controls human life and shapes the geographical environment (Erol, 1999). Climate has been an important issue since the existence of humanity. Many climate classification methods have been developed and used in line with the studies carried out by scientists conducting studies on climate. The most well-known of these methods include Köppen (1884), De Martonne (1942), Thornthwaite (1948), Strahler (1951), Emberger (1955), Holdridge (1947), Geiger (1961), Erinç (1965), Schendel (1968), Trewartha (1968), and Aydeniz (1973).

According to Kadıoğlu (2012), extreme weather events in recent years (such as temperature increases, intense and sudden rainfall, more frequent storms, etc.) have emerged as significant consequences of climate change. Furthermore, there is emphasis on how climate change leads to extreme weather events, and how these events in turn exacerbate socio-economic conditions, leading to disasters. This emphasis is discussed within the context of the project "Supporting Activities for the Preparation of Turkiye's Second National Declaration on the United Nations Framework Convention on Climate Change". This project highlights the need for adaptation efforts to reduce disaster risks associated with climate change, and conversely, for disaster risk reduction efforts to contribute to climate change adaptation (Kadıoğlu, 2012). In summary, in light of all these findings, it is strongly emphasized, particularly for Turkiye but also globally, that efforts must be made to prevent adverse effects stemming from climate change.

It is observed that meteorological and hydrological natural disasters are frequently encountered in Turkiye, as in the rest of the world. Especially due to Turkiye's geographical location, it has been determined that climate change varies significantly, and climate regions are classified differently. As a result of the presence of different climate regions, meteorological and hydrological disasters, particularly floods and flash floods, are frequently observed (Kadıoğlu, 2012). On the other hand, with the uncontrolled increase in temperature in Turkiye, climate change takes on different dimensions and this increase in temperature causes precipitation to become irregular. As a result, disaster events occur that affect a large segment of the society, such as floods, floods, drought, desertification, fire, and atmospheric changes (Akay, 2019).

Climate classification methods are used to make analyses such as regional and spatial climate classification, meteorological, agricultural, and hydrological droughts, humidity, forest fires, agricultural diversity, suitability for settlement, and tourism planning. Hydrological and climatological research is necessary to determine the interaction between water resources and settlement areas (Keskin Citiroglu, 2012).

In this study, climate boundary maps of Burdur province based on Geographic Information System (GIS) were created by applying Köppen, Trewartha, de Martonne, Aydeniz, Erinç, and Thornthwaite climate classification methods, along with the Kriging interpolation method. The climate classification methods selected in this study are those used in MGM (2017). Data from 11 meteorological stations located in Burdur province were used. Water balance sheets of the studied stations were prepared. Monthly average temperature and monthly total precipitation, as shown in the water balance sheets, were calculated for all stations between the years 1990 and 2020. The findings obtained as a result of this study are presented. Additionally, this study attempted to identify the water cycle and monthly variations between the atmosphere and the ground specific to the region.

It is believed that this study will provide guidance for the assessments that local governments will make regarding climate change and water crises. Furthermore, it is aimed that the results obtained in this study will contribute to future studies in which local governments in the province focus on integrated climate and water policies and contribute to these efforts.

2. The Importance of Creating Climate Boundary Maps

Today, climate change is causing serious concern worldwide. Changes in climate systems affect many sectors and have negative impacts on natural life. Therefore, efforts to combat climate change and adapt to it have become more critical than ever. Climate boundary maps are critical tools to guide decision-making processes in various sectors and to combat climate change.

Determining geographical boundaries is important in order to examine the effects of climate on the earth and to prevent the negative effects of climate change in a more planned and comprehensive way. Climate boundaries are determined by classifying different climate types; climate classifications emerge as important tools in drawing climate boundaries by addressing changes in climate types and analyzing and verifying changes occurring in climate types. Determining climate classes allows for temporal analysis of climate change monitoring, and changes in climate boundaries of different climate types can be tracked (Çolak and Memişoğlu Baykal, 2021).

Different climate classification methods have been developed to determine climatic boundaries. When the literature is examined, it is observed that climate classifications were first formulated by Wladimir Köppen in 1884 (Köppen, 1884) and have changed over time and appeared with different methods. Today, the most-used climate classification methods belong to Geiger (1961) (modified version of Köppen (1918)), de Martonne (1942), Holdridge (1947), Thornthwaite (1948), Strahler (1951), Emberger (1955), Erinç (1965), Trewartha (1968), Schendel (1968), and Aydeniz (1973). These methods enable detecting regional differences in climate types, examining their changes over the years, and creating different boundaries appropriate to climate types. Thus, it is possible to determine boundaries where regional climate differences are observed.

In Turkiye, studies are carried out both on climate classification and on developing methods in this field. Erinç (1949) initially classified climate types in Turkiye according to the Thornthwaite classification and then carried out a study on the degree of drought and humidity in Turkiye (Erinç, 1950) and revealed the equation named after him (Erinç, 1965). Ertürk and Bayar (1984) mapped the stations in Turkiye by revealing their monthly and annual status according to the Erinç formula. Sezer (1988), influenced by Thornthwaite climate classification, introduced the index named after him. Avcı (1992) and Çiçek (1996) analyzed the meteorological stations in Turkiye according to Thornthwaite climate classification. Ünal et al. (2003)'s cluster analysis results have a climate classification feature. A grouping study based on rainfall was also conducted by Türkeş and Tatlı (2011). The Holdridge life zone (HLZ) study by Tatlı and Dalfes (2016) has also been an important step in determining climate regions in Turkiye. The Thornthwaite climate database produced by Yılmaz and Çiçek (2016) has been a new study for determining Turkish climate regions, containing a considerable amount of detail. Öztürk et al. (2017) determined Turkiye's Köppen-Geiger climate types using monthly temperature and precipitation data, presenting the results in graphical and visual formats. Polat and Sünkar

(2017) determined the climate characteristics of Rize, Turkiye using the Thornthwaite climate classification method, utilizing long-term observation data from meteorological stations. Yılmaz and Çiçek (2018) identified detailed climate types in Turkiye according to the Köppen-Geiger method using monthly average temperature and total precipitation data, as well as global monthly average temperature and monthly total precipitation data with a resolution of approximately 30 minutes (about 1 km). Çelik et al. (2018) classified climate trends according to the Standardized Precipitation Index (SPI), Erinç, de Martonne, Aydeniz, and Thornthwaite climate classification methods based on meteorological data.

3. Materials and Methods

3.1. Study Area

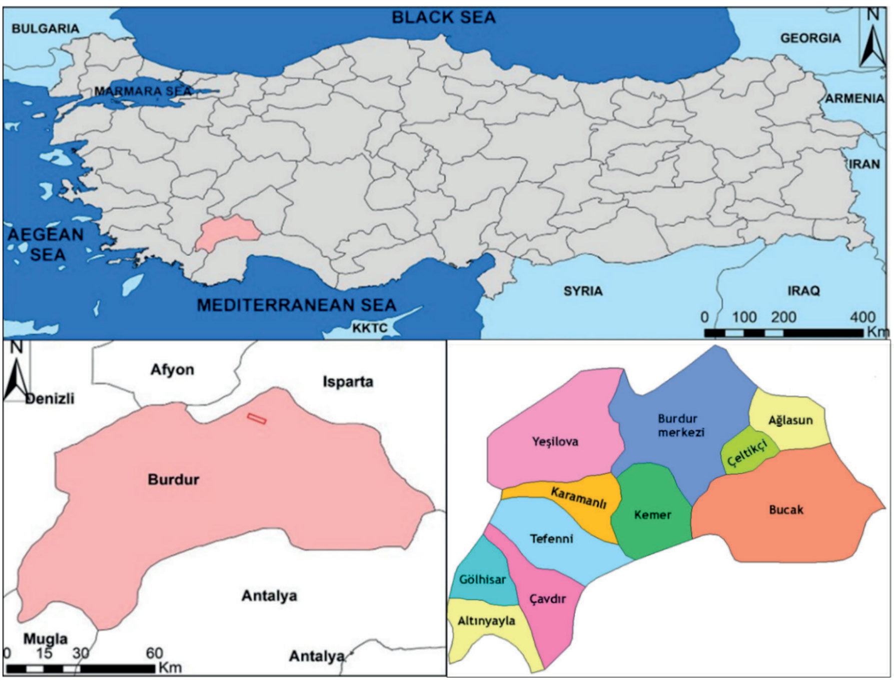

Figure 1. Location map of the study area

The study area, Burdur, is located between 29°22'-30°54' Eastern longitudes and 36°52'-°50' Northern latitudes (see Figure 1). Surrounded by Isparta in the east, Antalya in the south, Muğla and Denizli in the west and south-west parts, and Afyon provinces in the north, Burdur is an important city of the Western Mediterranean Region due to its transition position to the Aegean and Central Anatolia Regions. Burdur consists of 11 districts including Ağlasun, Altınyayla, Bucak, Burdur (Merkez), Çavdır, Çeltikçi, Gölhisar, Karamanlı, Kemer, Tefenni, and Yeşilova.

Among the important natural lakes within the Lakes Region where the entire province is located are Burdur Lake, Salda Lake, Yarışlı Lake, Karataş Lake, Gölhisar Lake, Çorak Lake, and Yazır Lake. In addition to the natural lakes that constitute the water resources of Burdur, there are also numerous ponds and dam lakes on the rivers within the province. Some of these are the Karacaören, Yapraklı, Karamanlı, Kozağacı, and Çavdır dam lakes (Ataol, 2010 Aksu and Güngör, 2020). Burdur's surface area is 7175 km^2 and 29693 hectares (4.14%) of it consists of water surfaces.

The altitude of Burdur province ranges from 75 meters to 2328 meters, with an average of 1000 meters. While the areas forming the lowest altitudes (75 m) of the province are located to the south of the Karacaören dam, which forms the border with Antalya, the Kestel Mountain (2328 m) on the southwest-northeast extending Katrancık Mountains forms the highest altitude areas of the province.

3.2. Data Acquisition for the Study

In this part of the study, the spatial data necessary for determining climate boundaries were identified using various methods. Data from 11 station points, including Ağlasun, Altınyayla, Bucak, Burdur (Merkez), Çavdır, Çeltikçi, Gölhisar, Karamanlı, Kemer, Tefenni, and Yeşilova, were used in the study. Data recorded over a 30-year period from 1991 to 2021 were obtained from Climate Data (2023) and subsequently associated with their respective locations. Climate Data (2023) data associated with the location of the station was transferred to the geographical database and the basis for analysis was prepared. Climate boundaries were determined using different methods, and the meteorological station data made ready for analysis was converted into the projection system selected in the spatial database. Then, it was made ready for analysis in the geographical database organized in GIS software.

Table 1. Station information used in the study

Station Name	Altitude (*m*)	Latitude	Longitude	Period
Ağlasun	1114	37°38'11.0"N	30°31'11.0"E	1991-2021
Altınyayla	1221	37°00'45.0"N	29°32'42.0"E	1991-2021
Bucak	807	37°29'35.0"N	30°33'42.3"E	1991-2021
Burdur (M.)	951	37°43'19.2"N	30°17'38.3"E	1991-2021
Çavdır	1064	37°09'21.0"N	29°42'57.0"E	1991-2021
Çeltikçi	858	37°33'51.0"N	30°26'33.0"E	1991-2021
Gölhisar	990	37°08'33.9"N	29°31'33.6"E	1991-2021
Karamanlı	1161	37°24'26.6"N	29°50'23.8"E	1991-2021
Kemer	1155	37°21'18.0"N	30°04'20.0"E	1991-2021
Tefenni	1149	37°18'57.9"N	29°46'45.2"E	1991-2021
Yeşilova	1218	37°30'02.0"N	29°44'27.0"E	1991-2021

3.3. Methods Used

In this study, different climate types were determined using the climate classification methods developed by Köppen, Trewartha, de Martonne, Aydeniz, Erinç, and Thornthwaite. Then, GIS-based climate boundary maps were created using the Kriging interpolation method to associate these data with location.

3.3.1. Köppen Climate Classification Method

The Köppen climate classification stands as one of the most commonly employed systems for categorizing climates. Initially presented by the German-Russian climatologist Wladimir Köppen in 1884 (Köppen, 1884), the classification underwent several revisions by Köppen himself (Köppen 1918, Köppen, 1936). Subsequently, German climatologist Rudolf Geiger introduced alterations to the classification (Geiger, 1954, Geiger 1961), leading to it being occasionally referred to as the Köppen–Geiger climate classification.

The Köppen climate classification is based on monthly and annual temperatures, annual precipitation amount, the distribution of precipitation throughout the year, and the relationship between precipitation and temperature with natural vegetation (Dönmez, 1984). Therefore, the

Köppen climate classification roughly conforms to a climate classification based on vegetation. According to the Köppen classification, climates are grouped into 30 types in 5 main zones. The main zones are represented by the letters A, B, C, D, and E, while the climate types are indicated by the second and third letters added to these letters. The second and third letters indicate the region's precipitation regime and temperature character, respectively.

The climate characteristics corresponding to Köppen climate classification method are given in Table 2.

Table 2. Köppen climate classification method

Letter symbol			Criteria	Climate classification
1st	2nd	3rd		
A			temperature of coolest month $\geq 18°C$	Tropical climates
A	f		precipitation in driest month $\geq 60\,mm$	Tropical rainforest climate
A	m		$100 - (r/25) \leq$ precipitation in driest month $< 60\,mm$	Tropical monsoon climate
A	w		precipitation in driest month $< \min(60\,mm, 100 - (r/25))$	Tropical savanna climate
B			70% or more of annual precipitation falls in the summer half of the year and $r < 20T + 280$, or 70% or more of annual precipitation falls in the winter half of the year and $r < 20T$, or neither half of the year has 70% or more of annual precipitation and $r < 20T + 140$	Arid climates
B	W	h	r is less than one-half of the upper limit for classification as a B type and $t \geq 18°C$	Hot desert climate
B	W	k	r is less than one-half of the upper limit for classification as a B type and $t < 18°C$	Cold desert climate
B	S	h	r is less than the upper limit for classification as a B type but is more than one-half of that amount and $t \geq 18°C$	Hot semi-arid climate
B	S	k	r is less than the upper limit for classification as a B type but is more than one-half of that amount and $t < 18°C$	Cold semi-arid climate

C			temperature of warmest month $\geq 10°C$ and $-3°C <$ temperature of coldest month $< 18°C$	Temperate climates
C	s	a	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half$))$ and temperature of warmest month $\geq 22°C$	Hot-summer Mediterranean climate
		b	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half$))$ and temperature of each of four warmest months $\geq 10°C$ but warmest month $< 22°C$	Warm-summer Mediterranean climate
		c	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half$))$ and temperature of one to three months $\geq 10°C$ but warmest month $< 22°C$	Cold-summer Mediterranean climate
	w	a	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half$)$ and temperature of warmest month $\geq 22°C$	Monsoon-influenced humid subtropical climate
		b	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half$)$ and temperature of each of four warmest months $\geq 10°C$ but warmest month $< 22°C$	Subtropical highland climate or Monsoon-influenced temperate oceanic climate
		c	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half$)$ and temperature of one to three months $\geq 10°C$ but warmest month $< 22°C$	Cold subtropical highland climate or Monsoon-influenced subpolar oceanic climate
	f	a	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of warmest month $\geq 22°C$	Humid subtropical climate
		b	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of each of four warmest months $\geq 10°C$ but warmest month $< 22°C$	Temperate oceanic climate or subtropical highland climate
		c	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of one to three months $\geq 10°C$ but warmest month $< 22°C$	Subpolar oceanic climate

D			temperature of warmest month $\geq 10°C$ and temperature of coldest month $\leq -3°C$	Continental climates
D	s	a	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half)) and temperature of warmest month $\geq 22°C$	Mediterranean-influenced hot-summer humid continental climate
		b	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half)) and temperature of each of four warmest months $\geq 10°C$ but warmest month $< 22°C$	Mediterranean-influenced warm-summer humid continental climate
		c	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half)) and temperature of one to three months $\geq 10°C$ but warmest month $< 22°C$	Mediterranean-influenced subarctic climate
		d	precipitation in driest month of summer half of the year $< \min(30\,mm, 1/3($precipitation in wettest month of the winter half)) and temperature of coldest month $< -38°C$	Mediterranean-influenced extremely cold subarctic climate
	w	a	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half) and temperature of warmest month $\geq 22°C$	Monsoon-influenced hot-summer humid continental climate
		b	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half) and temperature of each of four warmest months $\geq 10°C$ but warmest month $< 22°C$	Monsoon-influenced warm-summer humid continental climate
		c	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half) and temperature of one to three months $\geq 10°C$ but warmest month $< 22°C$	Monsoon-influenced subarctic climate
		d	precipitation in driest month of the winter half of the year $< 1/10($precipitation in the wettest month of the summer half) and temperature of coldest month $< -38°C$	Monsoon-influenced extremely cold subarctic climate
	f	a	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of warmest month $\geq 22°C$	Hot-summer humid continental climate
		b	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of each of four warmest months $\geq 10°C$ but warmest month $< 22°C$	Warm-summer humid continental climate
		c	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of one to three months $\geq 10°C$ but warmest month $< 22°C$	Subarctic climate
		d	precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied and temperature of coldest month $< -38°C$	Extremely cold subarctic climate

E			temperature of warmest month $< 10°C$	Polar and alpine climates
E	T		$0°C <$ temperature of warmest month $< 10°C$	Tundra climate
	F		temperature of warmest month $\leq 0°C$	Ice cap climate

Here, T represents the annual average temperature (°C), r represents the threshold value, summer months refer to the 6-month period from April to September, and winter months refer to the 6-month period from October to March. As can be seen from Table 2, to determine the B type (arid climates), the threshold value r needs to be calculated using eq. (1).

$$r = \begin{cases} 20T & \text{if 70\% or more of annual precipitation falls in the winter half of the year,} \\ 20T + 280 & \text{if 70\% or more of annual precipitation falls in the summer half of the year,} \\ 20T + 140 & \text{otherwise.} \end{cases} \quad (1)$$

Additionally, the descriptions of the third letters in Table 2 are provided in Table 3.

Table 3. Descriptions of the 3rd letters in the Köppen climate classification method

3rd letter	Description	3rd letter	Description
h	Hot steppe / Desert	b	Cold summer
k	Cold steppe / Desert	c	Cool summer, cold winter
a	Hot summer	d	Extreme cold

3.3.2. Trewartha Climate Classification Method

The Trewartha climate classification is a climate classification method first published by American geographer Glenn Thomas Trewartha in 1966. Trewartha climate classification is a modified version of the Köppen climate classification and also known to as the Köppen–Trewartha climate classification. This method redefines the main climate groups based on their proximity to vegetation zones.

- **A type** (Tropical climates): Defined in the same way as in the original Köppen climate classification (Köppen, 1918). The average temperature of all months is above 18°C. The number of dry months with rainfall below 60 *mm* does not exceed 2.
- **B type** (Arid and Semi-arid climates): The meanings of BW and BS are the same as in the Köppen climate classification. However, a different

formula is used to determine the drought threshold: $10(T-10)+3P^*$, where T is the annual average temperature, P^* is the ratio of summer precipitation from April to September. If the precipitation for a location is less than the formula value, it is considered a desert (BW). If the precipitation is equal to or greater than the formula value but less than twice the formula value, the climate is called steppe (BS) and if the precipitation exceeds twice the formula value, this climate is not B type.

- **C type** (Subtropical climates): In the Trewartha climate classification, this category represents subtropical climates. The average temperature for 8 or more months is above 10 °C. Cs and Cw have the same meaning as in the Köppen climate classification method. However, the subtropical climate does not have a clear arid boundary as in the Köppen climate classification (Cf). The average annual precipitation should be less than 890 mm. Additionally, dry summer months should receive less than 30 mm of precipitation and less than 1/3 of the precipitation in wet winter months.
- **D type** (Temperate and Continenetal climates): The average temperature of 4-7 months is above 10 °C. Marine temperate climates (Cfb and Cwb climates in the Köppen climate classification) are called Do in the Trewartha climate classification. For continental climates, the 3rd letter (a or b) is deleted and Dc is used instead. The threshold separating maritime and continental climate in the cold months is not -3 °C as in the Köppen climate classification but 0 °C.
- **E type** (Subarctic or Boreal climates): The average temperature for 1- 3 months is 10 °C or higher. It corresponds to the Cfc, Dfc, Dwc, Dsc, Dfd, and Dwd groups in the Köppen climate classification. In Trewartha climate classification, these groups are referred to as Eo and Ec. Eo represents marine subarctic, with the coldest month having an average temperature above -10 °C. Ec represents continental subarctic or boreal, with at least 1 month of having an average temperature of -10 °C or below.
- **F type** (Polar climates): Ft corresponds to the tundra climate, ET, in the Köppen climate classification. Similarly, Fi corresponds to the permafrost climate, EF, in the Köppen climate classification.
- **H type** (Mountain climates): Altitude plays a determining role in this climate type.

This climate classification is expanded by two code letters of the thermal standard scale, indicating the warmth of summer and the cold of winter corresponding to the maximum and minimum of the arithmetic mean monthly air temperature, given in Table 4 (Ikonen, 2007).

Table 4. Descriptions of the letters in the Trewartha climate classification method

Temperature (°C)	Letter	Description
>34	i	Severely hot
$28-34$	h	Very hot
$23-27$	a	Hot
$18-22$	b	Warm
$10-17$	l	Mild
$0-9$	k	Cool
$-9--1$	o	Cold
$-24--10$	c	Very cold
$-39--25$	d	Severely cold
<-39	e	Excessively cold

3.3.3. de Martonne Climate Classification Method

The de Martonne climate classification method was developed by French geographer Emmanuel de Martonne in 1942. This method takes into account the criteria of annual average temperature and annual total precipitation. In addition to these criteria, monthly evaluations are also conducted by determining monthly drought index values using monthly average temperature and monthly total precipitation values. Annual and monthly drought index values are respectively determined using the formulae given in eq.s (2) and (3) (de Martonne, 1942).

$$I_{DM} = \frac{P}{T+10} \tag{2}$$

$$I_M = \frac{12 \times p}{t + 10} \tag{3}$$

In these formulae, I_{DM} represents the annual drought index value, P represents the annual total precipitation, T represents the annual average temperature, I_M represents the monthly drought index value, p represents the monthly total precipitation, and t represents the monthly average temperature.

The climate characteristics corresponding to de Martonne climate classification method are given in Table 5.

Table 5. de Martonne climate classification method

Drought index (I_{DM})	Climate classification
<10	Arid
$10-20$	Semi-arid
$20-24$	Mediterranean (Moderately arid)
$24-28$	Semi-humid
$28-35$	Humid
$35-55$	Very humid
>55	Exteremely humid

3.3.4. Aydeniz Climate Classification Method

In his formula developed in 1973 regarding drought and precipitation, especially in determining drought periods and indices, Turkish professor of agriculture Akgün Aydeniz considered that the use of only precipitation and temperature parameters was insufficient, and that taking into account the relationship between humidity-precipitation and temperature-sunshine duration would yield more accurate results (Boluk, 2016). Considering the climatic conditions of Turkiye, Aydeniz developed two coefficients incorporating factors, such as precipitation, temperature, relative humidity, sunshine duration, and drought period affecting drought events (DMİ, 1988). These coefficients, called the humidity coefficient (N_{ks}) and the drought coefficient (K_{ks}), are obtained using eq.s (4) and (5).

$$N_{ks} = \frac{P \times RH}{T \times G_S + 15} \times N_p \tag{4}$$

$$K_{ks} = \frac{1}{N_{ks}}, \tag{5}$$

where, P is the monthly total precipitation (*cm*), T is the monthly average temperature (°C), *RH* is the monthly average relative humidity (%), G_S is the ratio of actual sunshine duration to theoretical sunshine duration varying according to each latitude degree (%), and N_p is the percentage of humid period (%).

N_p is obtained by dividing the number of months with a N_{ks} value greater than 0.40 by 12. In monthly calculations, 12 is used instead of N_p . To obtain G_S, it is necessary to determine the actual sunshine duration (length of the day), which depends on the latitude of the location and the angle of incidence of sunlight. The duration of a day in a location is determined by its latitude and the angle at which sunlight strikes. The angle between the sun's rays and the plane of the equator is known as the angle of declination (δ) and obtained by

$$\delta = 23.45 \times \sin\left(360 \times \frac{n}{365}\right). \tag{6}$$

Here, *n* is the number of days from January 1. Additionally, the angle between the longitude where the sunlight is present and the longitude of the observed location is referred to as the hour angle (*h*). The hour angle is measured from solar noon when the solar longitude is the same as the longitude of the observed location. It is expressed as negative (-) before solar noon and positive (+) after solar noon. The hour angle is calculated by

$$h = \arccos\left(-\tan \propto \times \tan \delta\right), \tag{7}$$

where $\propto$ is the degree of latitude. Since the absolute value of the cosine of the hour angle is less than or equal to 1, considering that a $15°$ hour angle corresponds to 1 hour of time, the length of the day is calculated by

$$t_g = \frac{2h}{15}. \tag{8}$$

The climate characteristics corresponding to Aydeniz climate classification method are given in Table 6 (Aydeniz, 1985).

Table 6. Aydeniz climate classification method

Humidity coefficient (N_{ks})	Drought coefficient (K_{ks})	Climate classification
< 0.40	> 2.50	Desert
$0.40 - 0.67$	$1.50 - 2.50$	Very arid
$0.67 - 1.00$	$1.00 - 1.50$	Arid
$1.00 - 1.33$	$0.75 - 1.00$	Semi-arid
$1.33 - 2.00$	$0.50 - 0.75$	Semi-humid
$2.00 - 4.00$	$0.25 - 0.50$	Humid
> 4.00	< 0.25	Very humid

3.3.5. Erinç Climate Classification Method

The Erinç Index is widely used by various researchers at different times to indicate Turkiye's drought problem and its dry/moist areas and periods (Bacanlı and Saf, 2005). This index depends on the ratio between the amount of precipitation and the amount of water lost by a location. The index obtained by directly proportioning precipitation amounts to average temperatures causes a more humid situation in continental regions than in reality. For this reason, Turkish geographer Sırrı Erinç took the average maximum temperature instead of the average temperature in calculating the index. However, in this evaluation, months in which the average maximum temperature falls below 0°C are disregarded assuming no evapotranspiration occurs.

Taking these factors into account, the formula Erinç (1965) devised is

$$I_m = \frac{P}{T_{om}}, \tag{9}$$

where I_m is the precipitation index, P is the annual precipitation amount (mm), T_{om} is the annual average maximum temperature.

The climate characteristics corresponding to Erinç climate classification method are given in Table 7.

Table 7. Erinç climate classification method

Precipitation index (I_m)	Climate classification	Vegetation
< 8	Hyper arid	Desert
$8-15$	Arid	Desertification
$15-23$	Semi-arid	Arid
$23-40$	Dry subhumid	Forest
$40-55$	Humid	Moist forest
> 455	Very humid	Very moist forest

3.3.6. Thornthwaite Climate Classification Method

The Thornthwaite climate classification is a climate classification system created by American climatologist Charles Warren Thornthwaite in 1931 and modified in 1948. Thornthwaite climate classification is based on precipitation-evaporation and temperature-evaporation relationships, and it is mostly used in hydrology studies (MGM, 2016, Yılmaz and Çiçek, 2016). According to Thornthwaite, in places where precipitation exceeds evaporation, the soil is saturated, indicating an abundance of water. Therefore, the climate of these areas is cosidered humid. On the contrary, in areas where precipitation is less than evaporation, the soil cannot retain enough water to meet the needs of plants, indicating a water deficiency. In these areas, the climate is considered arid. The climate types in Thornthwaite's classification fluctuate between these two extremes. Thornthwaite classified climates into two main groups based on the relationship between precipitation and evaporation: humid and arid climates, further divided into 6 humid and 3 arid categories based on severity. To apply this classification to a station, the following indices are calculated:

- Moisture index,

- Index of Thermal Efficiency (TE index),
- Aridity and Humidity indices,
- Index of the ratio of potential evaporation to the sum of three summer months' potential evaporation (Summer concentration of Thermal Efficiency) (Birsoy and Ölgen, 1992).

Based on these calculations, the climate type of the station is determined and symbolized by a separate letter. In Thornthwaite climate classification method, four letters are used.

The first letter of this climate classification is determined based on the obtained moisture index (I_m) value using Table 8.

Table 8. Descriptions of the 1st letters in the Thornthwaite climate classification method

Moisture index (I_m)	1st letter	Climate classification	
>100	A	Perhumid	Moist climates
$80-100$	B_4	Humid	
$60-80$	B_3	Humid	
$40-60$	B_2	Humid	
$20-40$	B_1	Humid	
$0-20$	C_2	Moist subhumid	
$-20-0$	C_1	Dry subhumid	Dry climates
$-40--20$	D	Semi-arid	
$-60--40$	E	Arid	

Evaporation refers to the transition of water from a liquid or solid state to a gaseous state (water vapor), while transpiration is the release of water vapor into the atmosphere from the bodies of plants. The combined process of evaporation and transpiration is referred to as evapotranspiration. The amount of water released into the atmosphere by the ground and vegetation, which are constantly and sufficiently fed by precipitation and groundwater, is called potential evapotranspiration (PE). However, precipitation and groundwater may not always supply the required water for potential evapotranspiration (PE). In such cases, the water released into the atmosphere by evapotranspiration from the soil, vegetation, and precipitation, if any, is termed actual evapotranspiration (ET) (Karaoğlu, 2011).

The index of Thermal Efficiency (TE index), which determines the second letter of this climate classification, is obtained using annual potential evapotranspiration (PE) values. TE index values and the corresponding letters are provided in Table 9.

Table 9. Descriptions of the 2nd letters in the Thornthwaite climate classification method

Annual PE (*mm*)	2nd letter	Climate classification
<142	E'	Frost
$142-285$	D'	Tundra
$285-427$	C'_1	Mild microthermal
$427-570$	C'_2	Microthermal
$570-712$	B'_1	Mild mesothermal
$712-855$	B'_2	Moderate mesothermal
$855-997$	B'_3	Strongly mesothermal
$997-1140$	B'_4	Mesothermal
>1140	A'	Megathermal

Where there is a water surplus amd no water deficiency, the ratio between water surplus and water need constitues an index of humidity. Similarly, where there is a water deficiency and no surplus, the ratio between water deficiency and water need constitues an index of aridity. Expressed as percentages these two indices are

$$I_h = \frac{100s}{n} \tag{10}$$

and

$$I_a = \frac{100d}{n}, \tag{11}$$

where I_h and I_a are indices of humidity and aridity, respectively, s is the water surplus, d is the water deficiency, and n the is water need (the annual potential evapotranspiration (PE)) (Thornthwaite, 1948).

The aridity index is used for moist climates (A_1, B, and C_2) while the humidity index is used for dry climates (C_1, D, and E) in determining the third letter of this climate classification (see Table 10).

Table 10. Descriptions of the 3rd letters in the Thornthwaite climate classification method

Aridity index (I_a)		3rd letter	Climate classification
for moist climates (A_1, B, C_2)	$0-16.7$	r	Little or no water deficiency
	$16.7-33.3$	s	Moderate summer water deficiency
	$16.7-33.3$	w	Moderate winter water deficiency
	>33.3	s_2	Large summer water deficiency
	>33.3	w_2	Large winter water deficiency
Humidity index (I_h)		**3rd letter**	**Climate classification**
for dry climates (C_1, D, E)	$0-10$	d	Little or no water surplus
	$10-20$	s	Moderate winter water surplus
	$10-20$	w	Moderate summer water surplus
	>20	s_2	Large winter water surplus
	>20	w_2	Large summer water surplus

The symbols s, s_2, w, and w_2 have the same meaning in both moist and dry climates in spite of the fact that they are defined differently. They refer to the season when rainfall is most deficient.

The moisture index is

$$I_m = I_h - 0.6 I_a = \frac{100s - 60d}{n}. \tag{12}$$

Moist climates have positive values of I_m, dry climates have negative values (Thornthwaite, 1948).

The fourth letter of this climate classification is determined by the ratio of potential evapotranspiration (PE) to the total PE values of the three warmest summer months, multiplied by 100 and divided by the annual PE amount. These letters indicate which of the marine or continental effects is dominant in that region (see Table 11).

Table 11. Descriptions of the 4th letters in the Thornthwaite climate classification method

Index of the ratio of PE to the sum of three summer months' PE	4th letter	Climate classification
< 48.0	a'	Marine
48.0 – 51.9	b'_4	↑
51.9 – 56.3	b'_3	
56.3 – 61.6	b'_2	
61.6 – 68.0	b'_1	
68.0 – 76.3	c'_1	
76.3 – 88.0	c'_2	↓
> 88.0	d	Continental

3.3.6.1. Application of the Thornthwaite climate classification method

The following steps are followed when applying the Thornthwaite climate classification method.

1. If the precipitation (P) is greater than the potential evapotranspiration (PE) for any month, the actual evapotranspiration (ET) equals the potential evapotranspiration (PE). The surplus of P over PE increases soil moisture reserves (storage). Once the storage reaches its maximum, the excess water turns into runoff.

2. If the precipitation (P) is less than the potential evapotranspiration (PE) for any month, the actual evapotranspiration (ET) equals the sum of that month's precipitation (P) value plus some or all of the available storage. When the storage reaches the drying point, the actual evapotranspiration (ET) equals the precipitation (P).

3. Temperature indices corresponding to the temperature values of each month are determined using

$$i = \left(\frac{t}{5}\right)^{1.514}. \qquad (13)$$

Here, t is the monthly average temperature in °C.

4. Using the formula given in eq. (14) below, the unadjusted potential evapotranspiration (PE) values based on temperature values are obtained.

$$PE = 16 \times \left(\frac{10 \times t}{I}\right)^{a}, \qquad (14)$$

where t is the monthly average temperature in °C, I is the annual temperature index obtained by summing up the monthly temperature indices, and

$$a = 0.000000675 \times I^3 - 0.0000771 \times I^2 + 0.01792 \times I + 0.49239. \qquad (15)$$

5. The adjusted potential evapotranspiration (PE) values are found by multiplying the unadjusted potential evapotranspiration (PE) values with the values of the latitude correction coefficient G in the chart given in Figure 2.

Latitude	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
60° N	0.54	0.67	0.97	1.19	1.33	1.56	1.55	1.33	1.07	0.84	0.58	0.48
50° N	0.71	0.84	0.98	1.14	1.28	1.36	1.33	1.21	1.06	0.9	0.76	0.68
40 °N	0.8	0.89	0.99	1.1	1.2	1.25	1.23	1.15	1.04	0.93	0.83	0.78
30° N	0.87	0.93	1	1.7	1.14	1.17	1.16	1.11	1.03	0.96	0.89	0.85
20° N	0.92	0.96	1	1.05	1.09	1.11	1.1	1.07	1.02	0.98	0.93	0.91
10° N	0.97	0.98	1	1.03	1.05	1.06	1.05	1.04	1.02	0.99	0.97	0.96
00° N	1	1	1	1	1	1	1	1	1	1	1	1
10°S	1.05	1.04	1.02	0.99	0.97	0.96	0.97	0.98	1	1.03	1.05	1.06
20° S	1.1	1.07	1.02	0.98	0.93	0.91	0.92	0.96	1	1.05	1.09	1.11
30° S	1.16	1.11	1.03	0.94	0.89	0.85	0.87	0.93	1	1.07	1.14	1.17
40°S	1.23	1.15	1.04	0.93	0.83	0.78	0.8	0.98	0.99	1.1	1.2	1.25
50° S	1.33	1.19	1.05	0.98	0.75	0.68	0.7	0.82	0.97	1.13	1.27	1.36

Figure 2. Values of the latitude correction coefficient G used in the Thornthwaite climate classification method (Al-Sudani, 2019).

Note that, for more accurate values of the coefficient G, it is recommended to use the exact latitude values of the study area. For example, when conducting studies related to areas with latitudes between 35°N and 38°N, using the values listed in Table 12 below would yield more accurate results.

Table 12. Values of the latitude correction coefficient G used in the Thornthwaite climate classification method for latitudes between 35°N and 38°N

Latitude	J	F	M	A	M	J	J	A	S	O	N	D
35°N	0.87	0.85	1.03	1.09	1.21	1.21	1.23	1.16	1.03	0.97	0.86	0.85
36°N	0.87	0.85	1.03	1.10	1.21	1.22	1.24	1.16	1.03	0.97	0.86	0.84
37°N	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83
38°N	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83

6. When calculating the water accumulated in the soil (storage) and its monthly change (storage change), start from the month when the potential evapotranspiration (PE) is greater than the precipitation (P). In this case, there is no water reserved in the soil, that is, the storage is empty. Reserved water (storage) only starts from the month when the precipitation (P) is higher than the potential evapotranspiration (PE), and this month is taken as basis for the water budget.
7. The actual evapotranspiration (ET) is the evaporation from the amount of water present in the soil at any given time. If the precipitation (P) is greater than the potential evapotranspiration (PE), the actual evapotranspiration (ET) equals the potential evapotranspiration (PE). If not, the actual evapotranspiration (ET) equals the difference between the precipitation (P) and the storage change.
8. Water deficiency is calculated by the difference between the potential evapotranspiration (PE) and actual evapotranspiration (ET) in months where the precipitation (P) is less than the potential evapotranspiration (PE).
9. Water surplus is calculated by the difference between the precipitation (P) and actual evapotranspiration (ET).
10. When calculating runoff, one should start from the month with the first water surplus. Half of the water surplus for that month is recorded as runoff, and the other half is added to the water surplus of the following month.
11. Moisture ratio is calculated by dividing the difference between the precipitation (P) and the potential evapotranspiration (PE) by the potential evapotranspiration (PE). If the result is positive, the water

is sufficient, if it is negative, it is insufficient, and if the result is zero, the excess water and the water deficiency are equal (Karaoğlu, 2011).

3.3.7 Kriging Interpolation Method

Kriging interpolation method is an interpolation technique that estimates the optimal values of data at other points using data from known nearby points (İnal et al., 2002; Yaprak and Arslan, 2008). The most significant feature that distinguishes the Kriging method from other interpolation methods is the ability to calculate a variance value for each predicted point or area, which serves as a measure of the confidence level of the estimated value (Yaprak and Arslan, 2008). The variance value obtained through this method is referred to as Kriging variance (Krige, 1951). The fundamental equation used in the Kriging interpolation method is given in eq. (16).

$$N_p = \sum_{t=1}^{n} P_i \times N_i, \tag{16}$$

where n is the number of points forming the model, N_i are the geoid undulation values of the points used in the calculation of N_p, N_p is the sought undulation value, and P_i is the weight value corresponding to each N_i value used in the calculation of N_p. The undulation value N_i at observation points from $i = 1 \ldots n$ is known. However, the weights to be assigned to these values need to be calculated. In Kriging interpolation method, these weights are determined such that the average of estimation errors is zero, and the variance is minimum.

4. Results and Discussion

In this section, the formulae used in Thornthwaite climate classification were applied to all the 11 districts of the study area (Burdur province), namely, Ağlasun, Altınyayla, Bucak, Burdur (Merkez), Çavdır, Çeltikçi, Gölhisar, Karamanlı, Kemer, Tefenni, and Yeşilova, and water balance tables were created for each district. Also, the results obtained using climate classification methods developed by Köppen, Trewartha, de Martonne, Aydeniz, Erinç, and Thornthwaite for all the 11 districts of the Burdur province are presented. So, this section is divided into subsections for each of the districts of the Burdur province. Subsequently, by using these station points on the point map via GIS, the surface model was created by selecting the Kriging interpolation method, one of the deterministic interpolation methods, to produce climate boundary maps. Thus, regional climate boundary maps were produced from meteorological points with a determined climate type and are presented in the last subsection.

Note that, the units of Unadjusted and Adjusted Evapotranspirations (Unadjusted and Adjusted PE), Precipitation (P), Storage, Storage change, Actual Evapotranspiration (ET), Water deficiency, Water surplus, and Runoff are *mm* and the unit of Temperature is °C. Moisture ratio and of Latitude correction coefficient *G* are unitless. Note also that, in order to make the calculations more precise, the DMS (degrees, minutes, seconds) latitude values of the districts of Burdur province given in Table 1 were converted to dd (decimal degrees) latitude values, and the more appropriate values of the latitude correction coefficient *G* are selected from Table 12 for each district. The conversion is given in Table 13.

Table 13. Latitude (DMS) to Latitude (dd) conversion

District	Latitude (DMS)	Latitude (dd)	District	Latitude (DMS)	Latitude (dd)
Ağlasun	37°38’11.0”N	37.6363°N	Gölhisar	37°08’33.9”N	37.1428°N
Altınyayla	37°00’45.0”N	37.0125°N	Karamanlı	37°24’26.6”N	37.4074°N
Bucak	37°29’35.0”N	37.4931°N	Kemer	37°21’18.0”N	37.3550°N
Burdur (M.)	37°43’19.2”N	37.7220°N	Tefenni	37°18’57.9”N	37.3161°N
Çavdır	37°09’21.0”N	37.1558°N	Yeşilova	37°30’02.0”N	37.5006°N
Çeltikçi	37°33’51.0”N	37.5642°N			

4.1. Ağlasun District

Table 14. Ağlasun district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	0.3	1.5	4.7	8.5	13.2	17.8	21.7	21.8	17.4	11.8	6.5	2.2	-
Temperature index	0.0	0.2	0.9	2.2	4.3	6.8	9.2	9.3	6.6	3.7	1.5	0.3	45.1
Latitude corr. coef. G	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83	-
Unadjusted PE	0.6	4.2	16.8	34.4	58.4	83.8	106.4	106.9	81.5	51.0	24.9	6.7	575.7
Adjusted PE	0.5	3.6	17.3	37.8	71.9	103.9	132.9	125.1	84.8	49.0	20.9	5.6	653.2
P	114.0	91.0	91.0	86.0	67.0	33.0	9.0	8.0	27.0	65.0	71.0	106.0	768.0
Storage	100.0	100.0	100.0	100.0	95.1	24.3	0.0	0.0	0.0	16.0	66.1	100.0	-
Storage change	0.0	0.0	0.0	0.0	-4.9	-70.9	-24.3	0.0	0.0	16.0	50.1	33.9	-
ET	0.5	3.6	17.3	37.8	71.9	103.9	33.3	8.0	27.0	49.0	20.9	5.6	378.7
Water deficiency	0.0	0.0	0.0	0.0	0.0	0.0	99.7	117.1	57.8	0.0	0.0	0.0	274.6
Water surplus	113.5	87.4	73.7	48.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.5	389.3
Runoff	73.4	80.4	77.0	62.6	31.3	15.7	7.8	3.9	2.0	1.0	0.5	33.5	389.1
Moisture ratio	218.7	24.5	4.3	1.3	-0.1	-0.7	-0.9	-0.9	-0.7	0.3	2.4	18.0	-

The water balance of Ağlasun district has been calculated according to the Thornthwaite method (Table 14). Upon examination of the water balance of the district, it is observed that there is a surplus of 389.3 *mm* of water during months with abundant rainfall, while there is a deficit of 274.6 *mm* of water during other months.

Table 15. Climate classifications of Ağlasun district

Methods	**Climate Classifications**			
Thornthwaite	B_1	B'_1	s_2	b'_3
	Humid (34.38)	Mild mesothermal (653.25)	Large summer water deficiency (I_a = 42.03)	Marine (55.41)
Erinç	Humid (44.50)			
Aydeniz	Semi-humid (N_{ks} = 1.90)			
de Martonne	Mediterranean (Moderately arid) (20.14)			
Trewartha	Temperate (D type)			
Köppen	Warm-summer Mediterranean climate (Csb)			

4.2. Altınyayla District

Table 16. Altınyayla district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	0.5	1.4	5.0	9.0	13.7	18.4	22.4	22.2	18.0	12.7	7.5	2.9	-
Temperature index	0.0	0.1	1.0	2.4	4.6	7.2	9.7	9.6	7.0	4.1	1.8	0.4	48.0
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	0.9	3.4	16.8	35.1	59.3	85.8	109.7	108.5	83.5	54.0	28.0	8.5	593.5
Adjusted PE	0.8	2.9	17.4	38.6	72.4	105.5	137.1	126.9	86.0	52.4	23.8	7.1	670.7
P	90.0	77.0	68.0	63.0	62.0	30.0	11.0	11.0	15.0	37.0	50.0	77.0	591.0
Storage	100.0	100.0	100.0	100.0	89.6	14.1	0.0	0.0	0.0	0.0	26.2	96.2	-
Storage change	3.8	0.0	0.0	0.0	-10.4	-75.5	-14.1	0.0	0.0	0.0	26.2	69.9	-
ET	0.8	2.9	17.4	38.6	72.4	105.5	25.1	11.0	15.0	37.0	23.8	7.1	356.5
Water deficiency	0.0	0.0	0.0	0.0	0.0	0.0	112.0	115.9	71.0	15.4	0.0	0.0	314.2
Water surplus	85.3	74.1	50.6	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	234.5
Runoff	42.7	58.4	54.5	39.5	19.7	9.9	4.9	2.5	1.2	0.6	0.3	0.2	234.3
Moisture ratio	109.3	25.7	2.9	0.6	-0.1	-0.7	-0.9	-0.9	-0.8	-0.3	1.1	9.9	-

The water balance of Altınyayla district has been calculated according to the Thornthwaite method (Table 16). Upon examination of the water balance of the district, it is observed that there is a surplus of 234.5 *mm* of water during months with abundant rainfall, while there is a deficit of 314.2 *mm* of water during other months.

Table 17. Climate classifications of Altınyayla district

Methods	**Climate Classifications**			
Thornthwaite	C_2	B'_1	s_2	b'_3
	Moist subhumid (6.85)	Mild mesothermal (670.73)	Large summer water deficiency (I_a = 46.85)	Marine (55.09)
Erinç	Dry subhumid (36.13)			
Aydeniz	Semi-arid (N_{ks} = 1.23)			
de Martonne	Semi-arid (16.03)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.3. Bucak District

Table 18. Bucak district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	2.3	3.7	7.0	10.9	15.8	20.7	24.8	24.8	20.1	14.1	8.5	4.1	-
Temperature index	0.3	0.6	1.7	3.3	5.7	8.6	11.3	11.3	8.2	4.8	2.2	0.7	58.8
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	4.2	8.3	20.5	38.4	64.9	95.2	122.9	122.9	91.3	55.3	27.0	9.6	660.6
Adjusted PE	3.6	7.0	21.1	42.2	79.2	117.1	153.7	143.8	94.0	53.6	22.9	8.0	746.4
P	146.0	109.0	102.0	90.0	71.0	31.0	9.0	8.0	30.0	80.0	92.0	142.0	910.0
Storage	100.0	100.0	100.0	100.0	91.8	5.7	0.0	0.0	0.0	26.4	95.4	100.0	-
Storage change	0.0	0.0	0.0	0.0	-8.2	-86.1	-5.7	0.0	0.0	26.4	69.1	4.6	-
ET	3.6	7.0	21.1	42.2	79.2	117.1	14.7	8.0	30.0	53.6	22.9	8.0	407.5
Water deficiency	0.0	0.0	0.0	0.0	0.0	0.0	139.0	135.8	64.0	0.0	0.0	0.0	338.9
Water surplus	142.4	102.0	80.9	47.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.5	502.5
Runoff	103.5	102.8	91.8	69.8	34.9	17.5	8.7	4.4	2.2	1.1	0.5	65.0	502.2
Moisture ratio	39.0	14.6	3.8	1.1	-0.1	-0.7	-0.9	-0.9	-0.7	0.5	3.0	16.8	-

The water balance of Bucak district has been calculated according to the Thornthwaite method (Table 18). Upon examination of the water balance of the district, it is observed that there is a surplus of 502.5 *mm* of water during months with abundant rainfall, while there is a deficit of 338.9 *mm* of water during other months.

Table 19. Climate classifications of Bucak district

Methods	**Climate Classifications**			
Thornthwaite	B_2	B'_2	s_2	b'_3
	Humid (40.08)	Moderate mesothermal (746.38)	Large summer water deficiency (I_a = 45.40)	Marine (55.55)
Erinç	Humid (48.47)			
Aydeniz	Semi-humid (N_{ks} = 1.73)			
de Martonne	Mediterranean (Moderately arid) (21.10)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.4.Burdur (Merkez) District

Table 20. Burdur (Merkez) district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	1.3	2.5	5.9	10.0	15.0	19.8	23.7	23.7	19.3	13.6	8.0	3.3	-
Temperature index	0.1	0.4	1.3	2.9	5.3	8.0	10.5	10.5	7.7	4.5	2.0	0.5	53.9
Latitude corr. coef. G	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83	-
Unadjusted PE	2.4	5.7	18.1	36.6	63.1	91.5	116.4	116.4	88.4	55.3	27.2	8.3	629.4
Adjusted PE	2.0	4.8	18.6	40.3	77.6	113.4	145.5	136.2	91.9	53.1	22.8	6.9	713.2
P	80.0	66.0	73.0	73.0	61.0	31.0	9.0	8.0	22.0	49.0	47.0	74.0	593.0
Storage	100.0	100.0	100.0	100.0	83.4	1.0	0.0	0.0	0.0	0.0	24.2	91.3	-
Storage change	8.7	0.0	0.0	0.0	-16.6	-82.4	-1.0	0.0	0.0	0.0	24.2	67.1	-
ET	2.0	4.8	18.6	40.3	77.6	113.4	10.0	8.0	22.0	49.0	22.8	6.9	375.5
Water deficiency	0.0	0.0	0.0	0.0	0.0	0.0	135.5	128.2	69.9	4.1	0.0	0.0	337.8
Water surplus	69.3	61.2	54.4	32.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	217.5
Runoff	34.6	47.9	51.1	41.9	21.0	10.5	5.2	2.6	1.3	0.7	0.3	0.2	217.4
Moisture ratio	38.5	12.7	2.9	0.8	-0.2	-0.7	-0.9	-0.9	-0.8	-0.1	1.1	9.7	-

The water balance of Burdur (Merkez) district has been calculated according to the Thornthwaite method (Table 20). Upon examination of the water balance of the district, it is observed that there is a surplus of 217.5 *mm* of water during months with abundant rainfall, while there is a deficit of 337.8 *mm* of water during other months.

Table 21. Climate classifications of Burdur (Merkez) district

Methods	**Climate Classifications**			
Thornthwaite	C_2	B'_2	s_2	b'_3
	Moist subhumid (2.09)	Moderate mesothermal (713.23)	Large summer water deficiency ($I_a = 47.36$)	Marine (55.40)
Erinç	Dry subhumid (34.75)			
Aydeniz	Semi-humid ($N_{ks} = 1.42$)			
de Martonne	Semi-arid (14.80)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.5. Çavdır District

Table 22. Çavdır district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	1.1	2.4	6.1	10.5	15.6	20.5	24.6	24.3	19.7	13.9	8.1	3.2	-
Temperature index	0.1	0.3	1.4	3.1	5.6	8.5	11.2	11.0	8.0	4.7	2.1	0.5	56.3
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	1.7	4.9	17.9	37.8	65.1	94.9	122.0	119.9	89.8	55.6	26.4	7.3	643.3
Adjusted PE	1.5	4.2	18.4	41.5	79.5	116.7	152.5	140.3	92.5	53.9	22.4	6.1	729.4
P	55.0	44.0	44.0	46.0	49.0	22.0	7.0	6.0	9.0	21.0	29.0	45.0	377.0
Storage	99.0	100.0	100.0	100.0	69.5	0.0	0.0	0.0	0.0	0.0	6.6	45.5	-
Storage change	53.5	1.0	0.0	0.0	-30.5	-69.5	0.0	0.0	0.0	0.0	6.6	38.9	-
ET	1.5	4.2	18.4	41.5	79.5	91.5	7.0	6.0	9.0	21.0	22.4	6.1	308.1
Water deficiency	0.0	0.0	0.0	0.0	0.0	25.2	145.5	134.3	83.5	32.9	0.0	0.0	421.3
Water surplus	0.0	38.8	25.6	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.9
Runoff	0.0	19.4	22.5	13.5	6.7	3.4	1.7	0.8	0.4	0.2	0.1	0.1	68.9
Moisture ratio	36.9	9.6	1.4	0.1	-0.4	-0.8	-1.0	-1.0	-0.9	-0.6	0.3	6.4	-

The water balance of Çavdır district has been calculated according to the Thornthwaite method (Table 22). Upon examination of the water balance of the district, it is observed that there is a surplus of 68.9 *mm* of water during months with abundant rainfall, while there is a deficit of 421.3 *mm* of water during other months.

Table 23. Climate classifications of Çavdır district

Methods	**Climate Classifications**			
Thornthwaite	D	B'$_2$	d	b'$_3$
	Semi-arid (-25.21)	Moderate mesothermal (729.41)	Little or no water surplus (I_a = 9.45)	Marine (56.14)
Erinç	Semi-arid (20.81)			
Aydeniz	Very arid (N_{ks} = 0.50)			
de Martonne	Arid (9.43)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.6. Çeltikçi District

Table 24. Çeltikçi district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	1.3	2.6	5.9	9.7	14.5	19.2	23.2	23.2	18.7	12.9	7.4	3.1	-
Temperature index	0.1	0.4	1.3	2.7	5.0	7.7	10.2	10.2	7.4	4.2	1.8	0.5	51.5
Latitude corr. coef. G	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83	-
Unadjusted PE	2.7	6.6	19.1	36.5	61.7	88.9	113.7	113.7	85.9	52.9	25.7	8.3	615.6
Adjusted PE	2.3	5.5	19.7	40.2	75.8	110.2	142.2	133.1	89.3	50.8	21.6	6.9	697.5
P	146.0	109.0	102.0	90.0	71.0	31.0	9.0	8.0	30.0	80.0	92.0	142.0	910.0
Storage	100.0	100.0	100.0	100.0	95.2	16.0	0.0	0.0	0.0	29.2	99.6	100.0	-
Storage change	0.0	0.0	0.0	0.0	-4.8	-79.2	-16.0	0.0	0.0	29.2	70.4	0.4	-
ET	2.3	5.5	19.7	40.2	75.8	110.2	25.0	8.0	30.0	50.8	21.6	6.9	395.9
Water deficiency	0.0	0.0	0.0	0.0	0.0	0.0	117.2	125.1	59.3	0.0	0.0	0.0	301.6
Water surplus	143.7	103.5	82.3	49.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.8	514.1
Runoff	105.6	104.5	93.4	71.6	35.8	17.9	9.0	4.5	2.2	1.1	0.6	67.7	513.8
Moisture ratio	63.5	18.7	4.2	1.2	-0.1	-0.7	-0.9	-0.9	-0.7	0.6	3.3	19.7	-

The water balance of Çeltikçi district has been calculated according to the Thornthwaite method (Table 24). Upon examination of the water balance of the district, it is observed that there is a surplus of 514.1 *mm* of water during months with abundant rainfall, while there is a deficit of 301.6 *mm* of water during other months.

Table 25. Climate classifications of Çeltikçi district

<table>
<tr><th>Methods</th><th colspan="4">Climate Classifications</th></tr>
<tr><td rowspan="2">Thornthwaite</td><td>B_2</td><td>B'_1</td><td>s_2</td><td>b'_3</td></tr>
<tr><td>Humid (47.77)</td><td>Mild mesothermal (697.47)</td><td>Large summer water deficiency (I_a = 43.24)</td><td>Marine (55.26)</td></tr>
<tr><td>Erinç</td><td colspan="4">Humid (52.12)</td></tr>
<tr><td>Aydeniz</td><td colspan="4">Humid (N_{ks} = 2.17)</td></tr>
<tr><td>de Martonne</td><td colspan="4">Mediterranean (Moderately arid) (22.31)</td></tr>
<tr><td>Trewartha</td><td colspan="4">Temperate (D type)</td></tr>
<tr><td>Köppen</td><td colspan="4">Hot-summer Mediterranean climate (Csa)</td></tr>
</table>

4.7. Gölhisar District

Table 26. Gölhisar district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	1.1	2.3	5.8	10.0	14.9	19.6	23.7	23.5	19.2	13.7	8.2	3.4	-
Temperature index	0.1	0.3	1.3	2.9	5.2	7.9	10.5	10.4	7.7	4.6	2.1	0.6	53.6
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	1.9	5.2	17.8	36.8	62.7	90.4	116.5	115.2	87.9	56.0	28.3	8.7	627.4
Adjusted PE	1.7	4.4	18.3	40.5	76.5	111.2	145.6	134.7	90.6	54.4	24.0	7.2	709.1
P	69.0	59.0	55.0	55.0	58.0	28.0	10.0	9.0	13.0	30.0	39.0	58.0	483.0
Storage	100.0	100.0	100.0	100.0	81.5	0.0	0.0	0.0	0.0	0.0	15.0	65.7	-
Storage change	34.3	0.0	0.0	0.0	-18.5	-81.5	0.0	0.0	0.0	0.0	15.0	50.8	-
ET	1.7	4.4	18.3	40.5	76.5	109.5	10.0	9.0	13.0	30.0	24.0	7.2	344.1
Water deficiency	0.0	0.0	0.0	0.0	0.0	1.7	135.6	125.7	77.6	24.4	0.0	0.0	365.0
Water surplus	33.1	54.6	36.7	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.9
Runoff	16.5	35.6	36.1	25.3	12.7	6.3	3.2	1.6	0.8	0.4	0.2	0.1	138.8
Moisture ratio	40.5	12.6	2.0	0.4	-0.2	-0.7	-0.9	-0.9	-0.9	-0.4	0.6	7.0	-

The water balance of Gölhisar district has been calculated according to the Thornthwaite method (Table 26). Upon examination of the water balance of the district, it is observed that there is a surplus of 138.9 *mm* of water during months with abundant rainfall, while there is a deficit of 365.0 *mm* of water during other months.

Table 27. Climate classifications of Gölhisar district

Methods	**Climate Classifications**			
Thornthwaite	C_1	B'_1	s	b'_3
	Dry subhumid (-11.29)	Mild mesothermal (709.06)	Moderate winter water surplus (I_h = 19.59)	Marine (55.22)
Erinç	Dry subhumid (27.77)			
Aydeniz	Arid (N_{ks} = 0.87)			
de Martonne	Semi-arid (12.53)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.8. Karamanlı District

Table 28. Karamanlı district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	0.7	2.0	5.4	9.7	14.7	19.5	23.5	23.3	18.8	13.1	7.5	2.7	-
Temperature index	0.1	0.2	1.1	2.7	5.1	7.9	10.4	10.3	7.4	4.3	1.8	0.4	51.8
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	1.2	4.6	16.9	36.4	62.6	90.6	115.6	114.3	86.3	53.8	26.0	6.8	615.1
Adjusted PE	1.0	3.9	17.4	40.0	76.4	111.4	144.5	133.7	88.9	52.2	22.1	5.7	697.1
P	55.0	44.0	44.0	46.0	49.0	22.0	7.0	6.0	9.0	21.0	29.0	45.0	377.0
Storage	100.0	100.0	100.0	100.0	72.6	0.0	0.0	0.0	0.0	0.0	6.9	46.3	-
Storage change	53.7	0.0	0.0	0.0	-27.4	-72.6	0.0	0.0	0.0	0.0	6.9	39.3	-
ET	1.0	3.9	17.4	40.0	76.4	94.6	7.0	6.0	9.0	21.0	22.1	5.7	304.0
Water deficiency	0.0	0.0	0.0	0.0	0.0	16.8	137.5	127.7	79.9	31.2	0.0	0.0	393.1
Water surplus	0.2	40.1	26.6	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.0
Runoff	0.1	20.1	23.4	14.7	7.3	3.7	1.8	0.9	0.5	0.2	0.1	0.1	72.9
Moisture ratio	53.7	10.4	1.5	0.2	-0.4	-0.8	-1.0	-1.0	-0.9	-0.6	0.3	6.9	-

The water balance of Karamanlı district has been calculated according to the Thornthwaite method (Table 28). Upon examination of the water balance of the district, it is observed that there is a surplus of 73.0 *mm* of water during months with abundant rainfall, while there is a deficit of 393.1 *mm* of water during other months.

Table 29. Climate classifications of Karamanlı district

Methods	**Climate Classifications**			
Thornthwaite	D	B'$_1$	s	b'$_3$
	Semi-arid (-23.37)	Mild mesothermal (697.13)	Moderate winter water surplus (I_h = 10.47)	Marine (55.89)
Erinç	Semi-arid (22.05)			
Aydeniz	Very arid (N_{ks} = 0.58)			
de Martonne	Arid (9.75)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.9. Kemer District

Table 30. Kemer district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	0.8	2.1	5.5	9.7	14.6	19.3	23.2	23.1	18.6	12.9	7.3	2.6	-
Temperature index	0.1	0.3	1.2	2.7	5.1	7.7	10.2	10.1	7.3	4.2	1.8	0.4	51.0
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	1.5	5.1	17.6	36.8	62.5	89.7	113.8	113.2	85.5	53.2	25.5	6.7	611.0
Adjusted PE	1.2	4.3	18.2	40.5	76.2	110.3	142.3	132.5	88.1	51.6	21.6	5.5	692.3
P	53.0	41.0	44.0	45.0	47.0	20.0	6.0	4.0	7.0	22.0	28.0	48.0	365.0
Storage	100.0	100.0	100.0	100.0	70.8	0.0	0.0	0.0	0.0	0.0	6.4	48.8	-
Storage change	51.2	0.0	0.0	0.0	-29.2	-70.8	0.0	0.0	0.0	0.0	6.4	42.5	-
ET	1.2	4.3	18.2	40.5	76.2	90.8	6.0	4.0	7.0	22.0	21.6	5.5	297.3
Water deficiency	0.0	0.0	0.0	0.0	0.0	19.5	136.3	128.5	81.1	29.6	0.0	0.0	395.0
Water surplus	0.6	36.7	25.8	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.7
Runoff	0.3	18.5	22.2	13.4	6.7	3.3	1.7	0.8	0.4	0.2	0.1	0.1	67.6
Moisture ratio	41.5	8.6	1.4	0.1	-0.4	-0.8	-1.0	-1.0	-0.9	-0.6	0.3	7.7	-

The water balance of Kemer district has been calculated according to the Thornthwaite method (Table 30). Upon examination of the water balance of the district, it is observed that there is a surplus of 67.7 *mm* of water during months with abundant rainfall, while there is a deficit of 395.0 *mm* of water during other months.

Table 31. Climate classifications of Kemer district

Methods	**Climate Classifications**			
Thornthwaite	D	B'1	d	b'3
	Semi-arid (-24.46)	Mild mesothermal (692.31)	Little or no water surplus (I_h = 9.78)	Marine (55.62)
Erinç	Semi-arid (21.30)			
Aydeniz	Arid (N_{ks} = 0.68)			
de Martonne	Arid (9.16)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.10. Tefenni District

Table 32. Tefenni district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	0.6	1.8	5.4	9.6	14.6	19.4	23.5	23.2	18.6	13.0	7.3	2.6	-
Temperature index	0.0	0.2	1.1	2.7	5.1	7.8	10.4	10.2	7.3	4.2	1.8	0.4	51.2
Latitude corr. coef. G	0.86	0.84	1.03	1.10	1.22	1.23	1.25	1.17	1.03	0.97	0.85	0.83	-
Unadjusted PE	1.0	4.1	17.1	36.2	62.3	90.2	115.7	113.8	85.4	53.6	25.3	6.6	611.4
Adjusted PE	0.8	3.5	17.6	39.8	76.1	110.9	144.6	133.1	88.0	52.0	21.5	5.5	693.5
P	55.0	44.0	44.0	46.0	49.0	22.0	7.0	6.0	9.0	21.0	29.0	45.0	377.0
Storage	100.0	100.0	100.0	100.0	72.9	0.0	0.0	0.0	0.0	0.0	7.5	47.0	-
Storage change	53.0	0.0	0.0	0.0	-27.1	-72.9	0.0	0.0	0.0	0.0	7.5	39.5	-
ET	0.8	3.5	17.6	39.8	76.1	94.9	7.0	6.0	9.0	21.0	21.5	5.5	302.8
Water deficiency	0.0	0.0	0.0	0.0	0.0	16.0	137.6	127.1	79.0	31.0	0.0	0.0	390.7
Water surplus	1.1	40.5	26.4	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.2
Runoff	0.6	20.6	23.5	14.8	7.4	3.7	1.9	0.9	0.5	0.2	0.1	0.1	74.2
Moisture ratio	63.8	11.7	1.5	0.2	-0.4	-0.8	-1.0	-1.0	-0.9	-0.6	0.3	7.2	-

The water balance of Tefenni district has been calculated according to the Thornthwaite method (Table 32). Upon examination of the water balance of the district, it is observed that there is a surplus of 74.2 *mm* of water during months with abundant rainfall, while there is a deficit of 390.7 *mm* of water during other months.

Table 33. Climate classifications of Tefenni district

Methods	**Climate Classifications**			
Thornthwaite	D	B'_1	s	b'_3
	Semi-arid (-23.10)	Mild mesothermal (693.50)	Moderate winter water surplus (I_h = 10.70)	Marine (56.05)
Erinç	Semi-arid (22.01)			
Aydeniz	Very arid (N_{ks} = 0.51)			
de Martonne	Arid (9.80)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.11. Yeşilova District

Table 34. Yeşilova district water balance

Months	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Temperature	1.0	2.2	5.7	9.9	14.9	19.7	23.7	23.6	19.1	13.4	7.8	3.0	-
Temperature index	0.1	0.3	1.2	2.8	5.2	8.0	10.5	10.5	7.6	4.4	2.0	0.5	53.1
Latitude corr. coef. G	0.85	0.84	1.03	1.10	1.23	1.24	1.25	1.17	1.04	0.96	0.84	0.83	-
Unadjusted PE	1.7	5.0	17.6	36.6	62.9	91.2	116.6	115.9	87.5	54.7	26.7	7.5	623.9
Adjusted PE	1.5	4.2	18.1	40.2	77.4	113.1	145.7	135.6	91.0	52.5	22.4	6.2	708.0
P	56.0	47.0	49.0	52.0	57.0	27.0	9.0	8.0	13.0	26.0	32.0	47.0	423.0
Storage	100.0	100.0	100.0	100.0	79.6	0.0	0.0	0.0	0.0	0.0	9.6	50.4	-
Storage change	49.6	0.0	0.0	0.0	-20.4	-79.6	0.0	0.0	0.0	0.0	9.6	40.8	-
ET	1.5	4.2	18.1	40.2	77.4	106.6	9.0	8.0	13.0	26.0	22.4	6.2	332.6
Water deficiency	0.0	0.0	0.0	0.0	0.0	6.5	136.7	127.6	78.0	26.5	0.0	0.0	375.4
Water surplus	4.9	42.8	30.9	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.4
Runoff	2.5	22.6	26.8	19.3	9.6	4.8	2.4	1.2	0.6	0.3	0.2	0.1	90.3
Moisture ratio	36.8	10.3	1.7	0.3	-0.3	-0.8	-0.9	-0.9	-0.9	-0.5	0.4	6.6	-

The water balance of Yeşilova district has been calculated according to the Thornthwaite method (Table 34). Upon examination of the water balance of the district, it is observed that there is a surplus of 90.4 *mm* of water during months with abundant rainfall, while there is a deficit of 375.4 *mm* of water during other months.

Table 35. Climate classifications of Yeşilova district

Methods	**Climate Classifications**			
Thornthwaite	C_1	B'$_1$	s	b'$_3$
	Dry subhumid (-19.04)	Mild mesothermal (707.99)	Moderate winter water surplus (I_h = 12.77)	Marine (55.71)
Erinç	Dry subhumid (24.51)			
Aydeniz	Very arid (N_{ks} 0.65)			
de Martonne	Semi-arid (11.04)			
Trewartha	Temperate (D type)			
Köppen	Hot-summer Mediterranean climate (Csa)			

4.11. Climate Boundary Maps

One of the most significant challenges in climate studies today is the lack of a sufficient number of station data. Many meteorological stations are often located within cities or along coastlines, resulting in insufficient coverage in high-altitude inland or mountainous regions. This deficiency is being addressed through the use of interpolation techniques aided by computer systems and Geographic Information Systems (GIS). Consequently, instead of relying solely on sample points taken along lines in the past, more comprehensive values are now being obtained on a pixel-by-pixel basis. In this context, for the production of climate maps covering Burdur province and its districts, the results obtained through the Thornthwaite climate classification method were analyzed using Kriging interpolation method in the GIS software and the climate boundary maps for the

- Moisture index,
- Index of Thermal Efficiency (TE index),
- Aridity and Humidity indices,

- Index of the ratio of potential evaporation to the sum of three summer months' potential evaporation (Summer concentration of Thermal Efficiency)

were created respectively in the Figures 3-6.

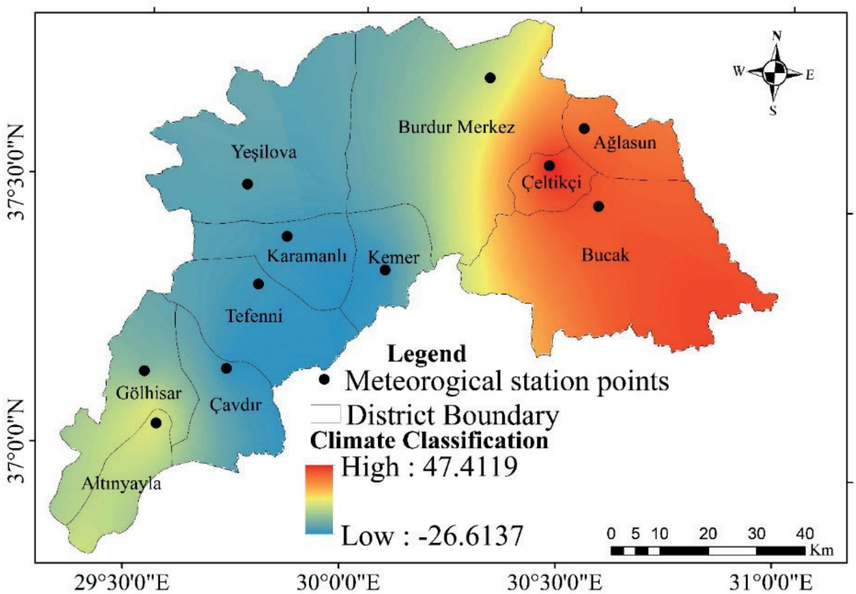

Figure 3. Moisture index map

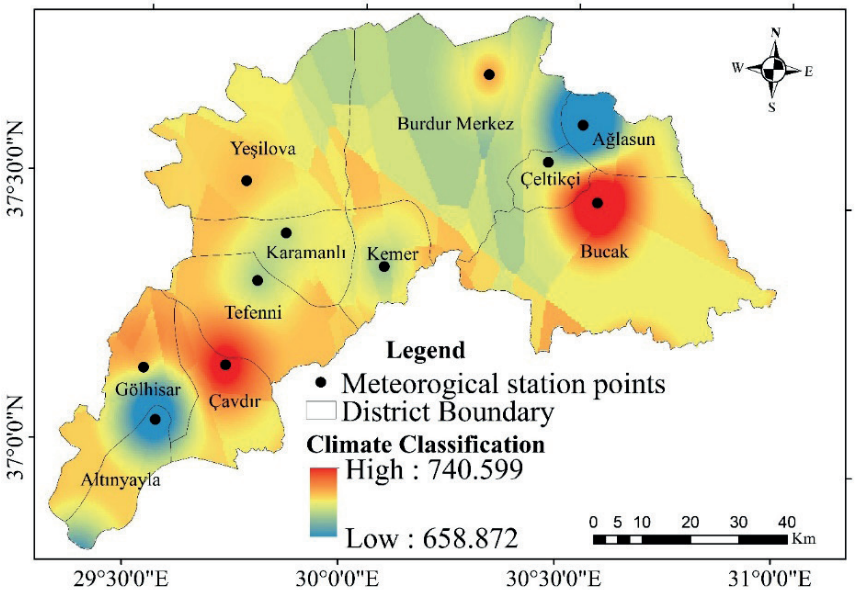

Figure 4. Index of Thermal Efficiency map

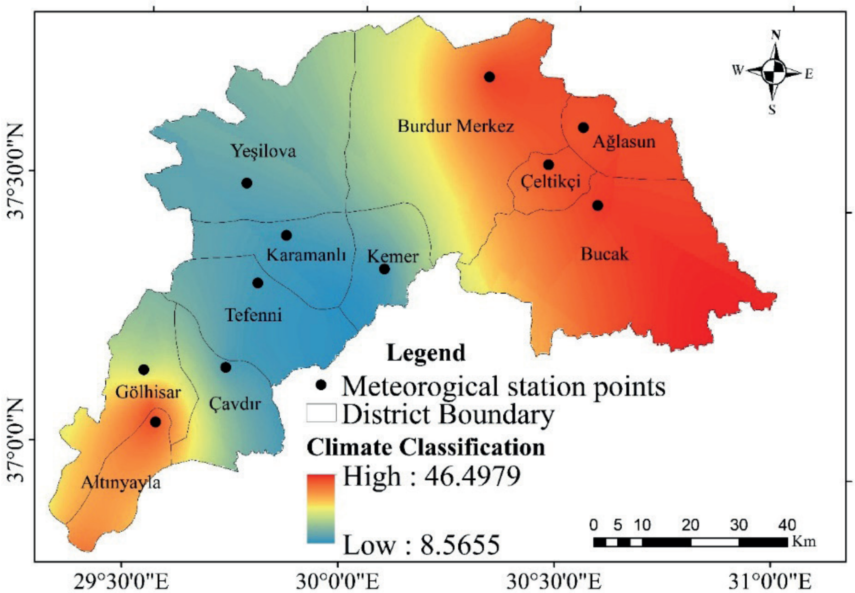

Figure 5. Aridity and Humidity indices map

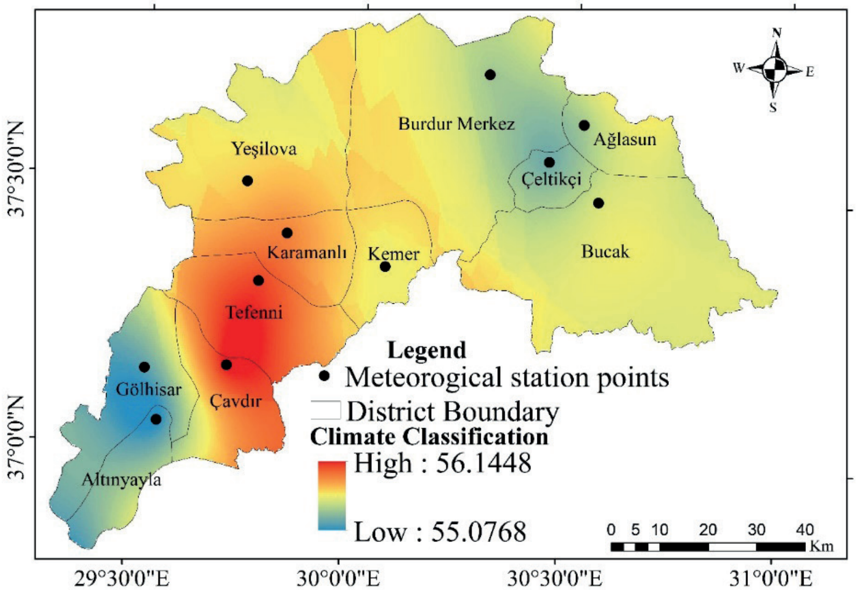

Figure 6. Index of the ratio of PE to the sum of three summer months' PE map

5. Conclusion

Knowing the climate characteristics of a region is crucial for planning various activities related to that area. This includes planning the cultivation of crops, establishing industrial facilities, determining suitability for healthy living conditions, and planning vacation destinations and timing. Therefore, in this study aimed at determining the climate type and water balance of Burdur province, climate indices were calculated using Thornthwaite, Erinç, Aydeniz, de Martonne, Trewartha and Köppen cliamte classification methods, utilizing monthly precipitation and temperature data from 11 stations within the borders of Burdur province.

According to the results obtained from the Thornthwaite method, Ağlasun, Bucak, and Çeltikçi stations are in the "humid" climate class, Altınyayla and Merkez districts are in the "moist subhumid" climate class, Gölhisar and Yeşilova stations are in the "dry subhumid" climate class, and Çavdır, Karamanlı, Kemer, and Tefenni stations are classified as "semi-arid" climates, all districts being characterized by their proximity to marine influences.

According to the results obtained from the Erinç method, Ağlasun, Bucak, and Çeltikçi districts are in the "humid" climate class, Altınyayla, Merkez, Gölhisar, and Yeşilova districts are in the "dry subhumid" climate class, and Çavdır, Karamanlı, Kemer, and Tefenni districts have a "semi-arid" climate classification.

According to the results obtained from the Aydeniz method, Çeltikçi district is in the "humid" climate class, Ağlasun, Bucak, and Merkez districts are in the "semi-humid" climate class, Altınyayla district is in the "semi-arid" climate class, Gölhisar and Kemer districts exhibit an "arid" climate characteristic, and Çavdır, Karamanlı, Tefenni, and Yeşilova districts have a "very arid" climate classification.

According to the results obtained from the De Martonne method, Ağlasun, Bucak, and Çeltikçi districts are in the "Mediterranean" climate class, Altınyayla, Merkez, Gölhisar, and Yeşilova districts are in the "semi-arid" climate class, and Çavdır, Karamanlı, Kemer, and Tefenni districts have an "arid" climate classification.

According to the results obtained from the Trewartha method, all districts have a "temperate" climate classification.

According to the results obtained from the Köppen method, Ağlasun district has a "Warm-summer Mediterranean climate" classification, while all other districts have a "Hot-summer Mediterranean climate" classification. It has been seen that similar results were obtained when all methods were examined.

Drought is a concerning condition for all life forms dependent on water-based activities. Whether it occurs due to climatic conditions or as a result of climate parameters disrupted by global warming, accurate prediction and analysis are crucial in minimizing the effects of drought. When looking at the application of climate modeling, it is generally observed that especially the districts of Çavdır, Karamanlı, Kemer, and Tefenni exhibit a drier characteristic compared to the other districts.

The water balance tables generated in our study enable the identification and assessment of potential floods and water shortages, facilitating the determination and storage of necessary water supplies during surplus and deficit months. Maintaining a balance between stored water in reservoirs and water usage for irrigation purposes requires an understanding of the region's climate type and water budget.

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