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Analysing Climatic Characteristics for the Suitability of Some Tourism Types in the Case of Erzurum City Centre

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Abstract

According to United Nations World Tourism Organisation (UNWTO), tourism offers all over the world cultural, environmental and social (peace and security) benefits, as well as provides employment (creating jobs), economic growth and development. Tourism accounted for 1/10 of jobs created in the world, 10% of the World's GDP (1.6 trillion by 2030 1.8 US Dollars), 7% of all exports, and 30% of all service exports in the world in 2017. Tourism grows the fastest with oil, food and automotive industries all over the world by increasing the number of destinations and income sources of most developing countries and supporting several sectors from construction to agriculture or telecommunications. In such a vitally important sector, competition among destinations is inevitable and its economic contribution is related to the service quality and the high revenues. In such a high competition, every type of potential or resource is given to the benefit of the tourism sector and used in promotional materials even, marketing and branding efforts e.g. quality of the snow cover or sun and beaches. Climate characteristics are vitally important for tourism to ensure both loyalty and branding and incomes. For nearly 50 years several climate indices on tourism have been developed to show the advantages of climatic characteristics at a given tourist destination. This study aims to analyse the climate of Erzurum city, a winter destination, through Climate and Tourism Information Schemes (CTIS) based mainly on bioclimatic comfort conditions as well as effective climatic parameters on tourism differently from other indices. Results show that even though bioclimatic comfort values address extreme cold stress in the winter tourism season, the area is suitable for winter tourism when considering other climatic parameters. It can be stated as a conclusion that a unique tourism climate index to Turkey should be developed by taking into account the prevalent tourism types mainly winter and 3 – S tourism.

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1. Introduction

The tourism sector has been the fastest-growing one over the last 30 to 40 years and contributing larger to the socio-economic development of nations compared to other outstanding sectors. With such a big capacity tourism may constitute the main revenue source for several developing countries. An increase in the present and prospected number of tourists and the amount of tourism revenue has caused a boom in also the number and variety of candidate destinations and keen rivalry between them. Service quality and accordingly the tourism income deeply affect the tourism's contributions to national economies. According to UNWTO (2019a), the sector accounted for 7% of total global exports, 30% of service exports and 10% of world GDP and one-tenth of the employment in the world in 2018. Visitor numbers all over the world rose by 5% in 2018 to 1.451 billion and the sector produced a revenue reaching USD 1.7 trillion (UNWTO, 2019b).

Climatic characteristics are known to have affected and shaped all human activities and behaviours together with physical properties throughout human history. Well, known examples of the climatic impact on humans are on public health, urbanisation, economic activities like agriculture depending especially on outdoor and atmospheric activities. Therefore, humans have survived their lives, not in conflict but convenience with climatic conditions since their first existence on the earth by developing adaptation to the atmospheric environment until the Industrial Revolution nearly 200 years before.

In IPCC (2018) Summary for Policy Makers Report, human activities are reported to be responsible for nearly 1.0°C temperature increase all over the world (between 0.8°C and 1.2°C) compared to that in pre-industrial period and case present situation continues this increase is estimated to reach 1.5°C between 2030 and 2052. The impact of climate change is now affecting human activities more violently and deeply than before by causing large–scale economic and social losses.

Among human activities, tourism and leisure are more recently introduced and developed ones in their present form compared to agriculture, trade or industry. However, tourism is among the fastest-growing economic sectors since its inception except for the periods of global crises caused by economic recessions, terrorism, wars and pandemics as it is in today. For instance, according to United Nations World Tourism Organisation (UNWTO, 2020), the number of international tourists worldwide continued to grow exceptionally in 2017, 2018 and 2019 at a considerably high rate by +7; 6; and 4% respectively and tourist number reached 1.5 billion in 2019 in the world. Based on the trends mentioned above, UNWTO forecast at the beginning of 2020 a growth by 3% to 4% in international tourist arrivals worldwide however the in-pandemic period this happened as a loss of 70%. Despite all negative impacts and fragilities on the sector, World Travel & Tourism Council's (WTTC) latest annual research in conjunction with Oxford Economics, revealed that the tourism sector's growth rate has been larger than global economic growth for nine years. In addition, in the global economy tourism is responsible for one–fourth of new employment and one-tenth of whole employment in the world, 10.3% of global GDP, 6.8% of total world exports, 28.3% of global services exports and 4.3% of total investment.

Although tourism is an economic sector, it is more than that for a destination, which may be at local, regional, and national scale, involving various impacts for nations such as social, cultural, environmental even psychological and political ones. To evaluate a location's suitability for tourism activities daily weather conditions, as well as climate, are accepted to be considerably effective in addition to the potentials resulting from geographical characteristics including topography, location on the earth, flora and fauna. From a reverse point of view, climate and weather conditions can also play confining and outlining role over the potentials serving for tourism (Rudel et al., 2007) thus determining the tourism types at a destination e.g. winter, summer, nature – adventure etc. Tourism is among the sectors highly sensitive to climate and the changes in climatic elements. On the other side, carbon-emitting activities in the tourism value chain also have a negative impact on climate therefore as in all other human activities tourism also contributes and is affected by climate change.

Not only meteorological and climatic parameters but also the characteristics like topography, location, flora and fauna play important roles for tourism performance of a region since climate enables or hinders the convenience of the area for tourism (Abegg, 1996; De Freitas, 2003; Gómez Martín, 2005; Rudel et al., 2007; Scott & Lemieux, 2010; Scott et al., 2012, Kovacs et al., 2017).

Climate parameters related to temperature i.e. mean, maximum and minimum, relative humidity, precipitation, solar radiation and wind speed affect the performance of tourism activities (Fanger, 1970; Scott et al., 2004; Lin & Matzarakis, 2008; Zaninovic & Matzarakis, 2009; Fröhlich & Matzarakis 2012). The mentioned parameters can influence the quality of experience visitors gain in a destination and then tourist satisfaction, revenue and loyalty when an evaluated individual or combined effects of these parameters (Morgan et al., 2000; Kozak, 2002; Hübner & Gössling, 2012). In addition, climatic conditions are also effective in decision making for holidays and destinations (Hamilton & Lau, 2005; Gössling et al., 2006; Scott et al., 2008, 2012; Moreno, 2010; Scott & Lemieux, 2010). In short, tourism as a set of outdoor activities is susceptible to variabilities in climatic elements and climate change (Kovacs, 2017).

Climatic impacts on the tourism sector have been studied since nearly the rise of the sector considering the combined effects of parameters as the input for some models to develop, calculate, estimate concrete values about the climatic characteristics of a destination. A serious number of tourism climate indices analysing climate characteristics of a destination were developed for its suitability of tourism activities (e.g. Pegay 1961; Heurtier 1968; Besancenot et al., 1978; Mieczkowski, 1985; Becker, 1998; Morgan et al., 2000; Scott et al., 2004). Even though the number is supposed to have changed today, Amiranashvili et al. (2008) mentioned more than 200 climate indices in applied climatology and human biometeorology which can be used for the tourism sector.

In the 2000s, Turkey has targeted long term strategies devoted to the 100th anniversary of the foundation of the Turkish Republic and realized these targets earlier by increasing the tourist number and revenue. In the last year before the pandemic, 2019, 51.7 million tourists were reported to visit the country and in return for USD 34.5 billion

(TurkStat, 2020). Turkey has enlarged its targets in the strategies prepared both nationally and regionally whose overall objectives are to expand tourism activities whole year and to those other than all-inclusive 3S (sea – sand-sun), i.e. alternative, nature-based and high–income generating tourism types, e.g. sport and health tourism.
From local to the regional and national level, Turkey has adopted some concrete priorities to develop the tourism sector by first defining the tourism potentials of destination candidates to invest to construct physical and social infrastructure. From this point of view, the city of Erzurum and the NUTS II region covering it (TRA1; Northeast Anatolia) together with the provinces of Erzincan and Bayburt shelters potentials suitable for alternative tourism types especially winter and nature – adventure tourism. The region carries potentials for winter tourism for its topography and climate (internationally famed Palandöken Ski Centre), culture and history tourism deep historical background, nature and adventure tourism for being at the beginning of water resources (three rivers in Turkey) (KUDAKA 2011). Potentials of the region can serve six types of alternative tourism; winter, culture and history, adventure and nature, eco and agro, health, and congress tourism (KUDAKA, 2011).

The city of Erzurum has extreme continental climatic characteristics which cause cold stress for nearly six months from November to late May with a record temperature of -37.2 °C. This situation offers potentials for winter tourism while generally cool and neutral summers provide opportunities for high-performance sports, nature – adventure activities and sportive camping etc. Because of the importance of mentioned activities for the region, any scientific study shedding light on future investments and projects for the development of tourism in the region is urgently needed and may help smooth the inter-regional development disparities.

The objective of the present study is to evaluate the climatic characteristics of a Turkish city, Erzurum as a winter tourism destination using a new and complete tourism climate index; Climate-Tourism-Information-Scheme (CTIS; Matzarakis, 2007) and some suggestions were offered to develop tourism in the region.

2. Data and Method

Atmospheric characteristics which constitute climatic elements have direct or indirect effects on people performing various outdoor activities. Among such elements largely effective on tourism and leisure activities are given in Table 1.

Table 1. Effective climate elements on tourism (Source: Author)

	Hourly Trends	Mean			Maximum			Minimum			Extreme			Total		
		Daily	Monthly	Yearly	Daily	Monthly	Yearly	Daily	Monthly	Yearly	Daily	Monthly	Yearly	Daily	Monthly	Yearly
Air Temperature (°C)	■	■	■	■	■	■	■	■	■	■	■	■	■			
Relative Humidity (RH%)	■	■	■	■	■	■	■	■	■	■						
Wind Direction (° prevalent)		■	■	■												
Wind Speed (m/sec)	■	■	■	■	■	■	■	■	■	■	■					
Vapour Pressure (hPa)	■	■	■	■	■	■	■	■	■	■						
Cloudiness (oktas)		■	■	■												
Rainfall (mm/m2)		■	■	■							■	■	■	■	■	■
Type of precipitation		■	■	■												
Sunshine Duration (h)		■	■	■												
Solar Radiation (w/m2)		■	■	■												
Snow Cover (cm)		■	■	■	■	■	■	■	■	■	■	■	■			
Number of Snow Covered Days		■	■	■										■	■	■
Number of Snowy Days		■	■	■										■	■	■
Number of Wet Days		■	■	■										■	■	■
Number of Sky Clear / Over-cast Days		■	■	■												

Climate-Tourism-Information-Schemes (CTIS; Matzarakis, 2007) was adopted to evaluate the climate of Erzurum city for tourism activities. Evaluation of climatic features for tourism activities has been performed for a while through some indices using either complex or simple methodologies to show the impacts of climatic elements by grading the conditions for tourism (Mieczkowski, 1985; de Freitas, 2008). One of the components to evaluate climate for outdoor activities including tourism is human thermal comfort conditions, therefore indices using thermal comfort analyses have advantages to reveal potentials of climatic features in an area.

Climate-Tourism-Information-Schemes (CTIS; Matzarakis, 2007) employs Physiologically Equivalent Temperature (PET; Mayer & Höppe 1987; Höppe, 1999; Matzarakis et al. 1999), widely preferred thermal comfort index in tourism and climate studies (Lin & Matzarakis 2008) and considers the effective factors (Matzarakis & Gulyas 2007; Farajzadeh & Matzarakis 2009). CTIS assesses effective climatic parameters (e.g. those in Table 1) and creates frequency classes, threshold values and high temporal resolution using decades (ten-day intervals), climatological and human-biometeorological conditions, thermal comfort, heat stress, cold stress and "sultriness" based on human-biometeorological thresholds and human energy balance i.e. PET, rainfall and precipitation types i.e. snow cover, dry days or wet days, fog and sunshine/cloudiness, wind conditions (Matzarakis, 2007). Depending on climate change there is an apparent increase in the formation of extreme meteorological events, the high temporal resolution of this index enables to catch these extreme events rather than long term averages (e.g. monthly, yearly averages). Effects of various climatic parameters can be evaluated either together or individually by presenting them in percentages and the parameters to be evaluated can be included in the index depending on their importance for the tourism and destination types (Matzarakis, 2007). Calculation of PET values was performed using RayMan (Matzarakis et al., 2007, 2010) and hourly data – air temperature (Ta °C), relative humidity (RH; %), cloudiness (CA; in octas), wind speed (WS m/s) measured at airport weather observation station from 1950 to 2016 (operated by the Turkish State Meteorological Service (MGM), located at 1758m MSL; 39º.57'N-41º.10'E; 7 – km away from the city centre). PET values calculated for standardised European man (gender), who is 1.75 m (height), 75 kg (weight), at 35 years old, in work suit (clothing 0.9 clo) and working in an office (activity 80 w) and in a standing position (Höppe 1999; Mayer & Höppe 1987) were categorised according to Table 2.

Threshold values are accepted in the study (in Table 2), as in Matzarakis (2007).

Table 2. Effective parameters and their threshold values in CTIS (Matzarakis, 2007; Matzarakis & Endler 2009)

Effective parameters	Threshold values
Thermal acceptance	PET between 18 °C and 29 °C
Heat stress	PET > 35 °C
Cold stress	PET < 8 °C
Cloudy	> 5 octas
Fogy	based on relative humidity > 93 %
Sultry	based on vapour pressure > 18 hPa
Dray	precipitation < 1 mm
Wet	precipitation > 5 mm
Windy	wind speed > 8 m/s
Ski potential	Snow cover >10 cm

3. Study Area

The study area, the city of Erzurum, is located in the northeast Anatolia Region of Turkey (39.55N and 41.16E; TRA1 NUTSII Region; Figure 1), from 1.850m to 2.100m in the city centre. According to TurkStat (2019), 762.062 people live in the province and nearly 400 thousand in the city centre.

Figure 1. Location of Erzurum (Source: googleearth)

The city has harsh continental climate characteristics (Köppen climate classification Dfd; Toy et al., 2016). The long-term yearly average temperature is 5.1°C (temperature extremes −37.2°C and 35.6°C), rainfall is 403.3 mm and relative humidity is 66.3% on yearly basis (Figure 2; Table 1). Prevalent wind directions are ENE in summer and WSW in winter.

Figure 2. Long-term temperature parameters in Erzurum (Source: Author)

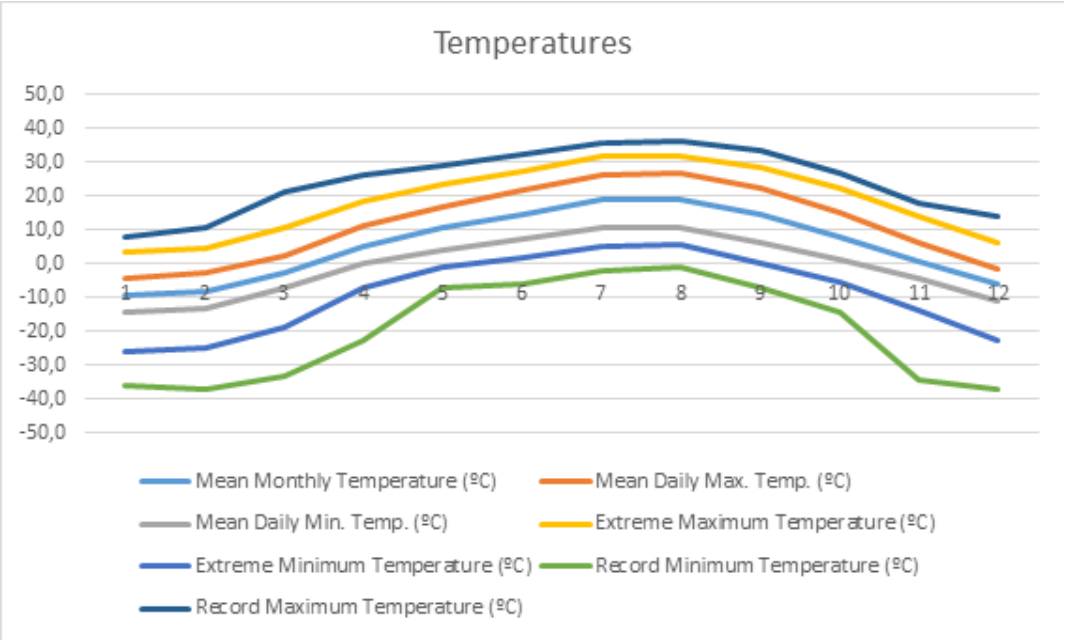

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Figure 3. Long-term rainfall, wet days and relative humidity parameters in Erzurum (Source: Author)

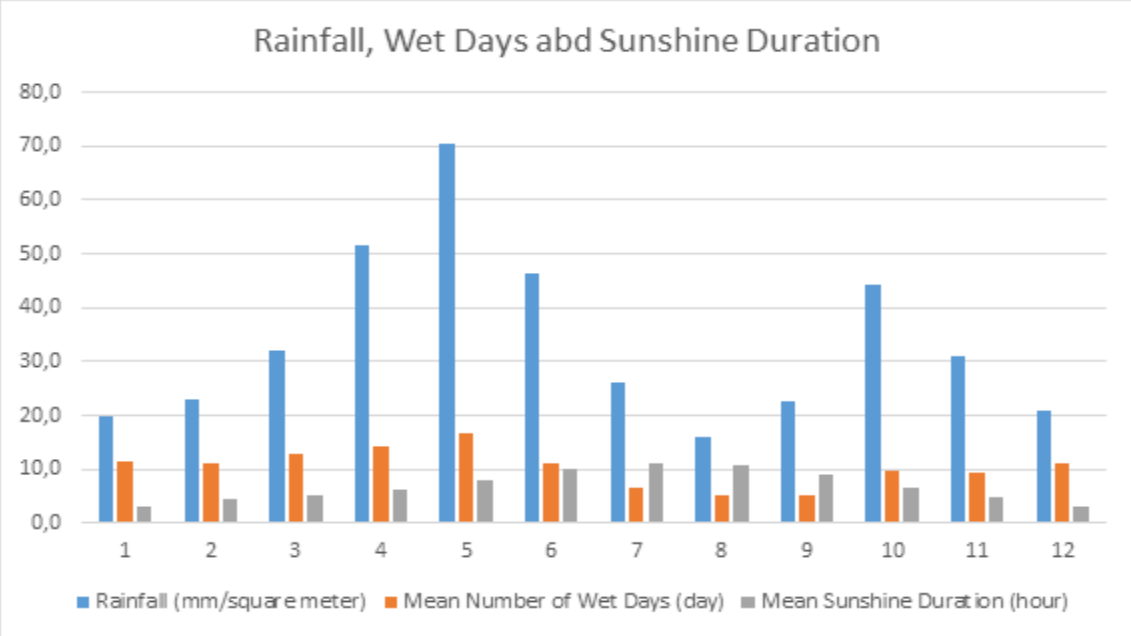


Figure 4. Long-term rainfall, wet days and relative humidity parameters in Erzurum (Source: Author)

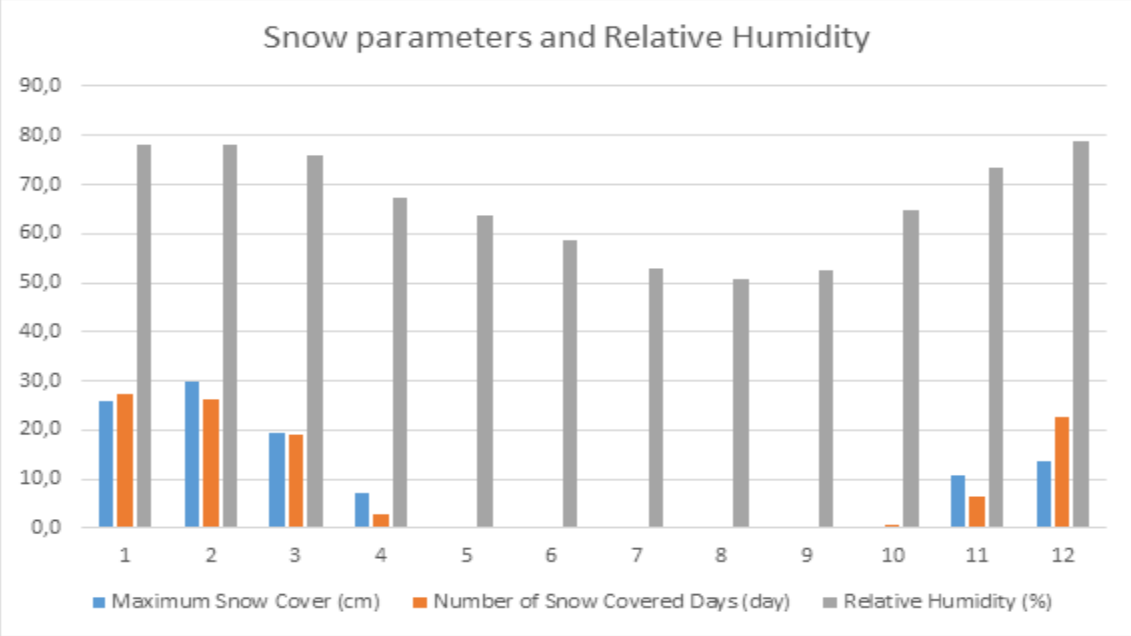


Table 3. Long term yearly means and a total of some meteorological parameters (Source: Author)

Parameters		Mean	7	Record Maximum Temperature (ºC)	24,3
1	Mean Monthly Temperature (ºC)	5.6	8	Maximum Snow Cover (cm)	17.8
2	Mean Daily Maximum Temperature (ºC)	11.9	9	Number of Snow Covered Days (day)	13.2
3	Mean Daily Minimum Temperature (ºC)	-0.6	10	Relative Humidity (%)	66.3
4	Extreme Maximum Temperature (ºC)	18.7	11	Rainfall (mm/square meter)	403.3
5	Extreme Minimum Temperature (ºC)	-8.7	12	Mean Number of Wet Days (day)	10.3
6	Record Minimum Temperature (ºC)	-19.7	13	Mean Sunshine Duration (hour)	6.9

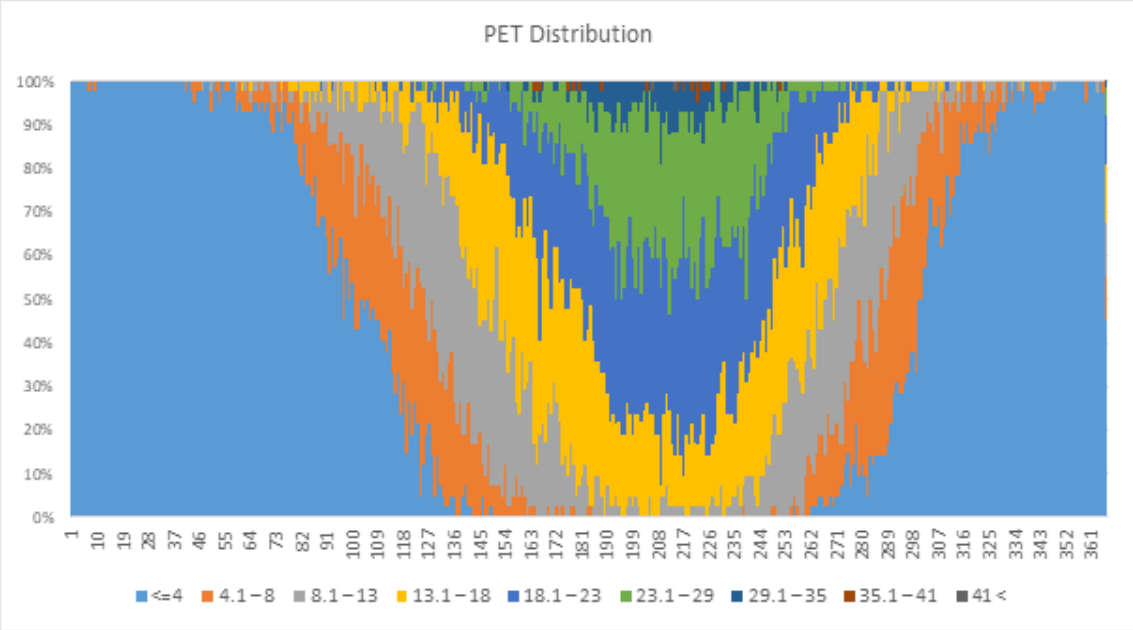
Table 4. Thermal sensation and stress levels of PET (Matzarakis & Mayer 1996)

Thermal stress level	Human sensation	PET (°C)
Extreme cold stress	Very cold	<4
Strong cold stress	Cold	4.1-8.0
Moderate cold stress	Cool	8.1-13.0
Slight cold stress	Slightly cool	13.1 – 18.0
No thermal stress	Comfortable	18.1-23.0
Slight heat stress	Slightly warm	23.1-29.0
Moderate heat stress	Warm	29.1-35.0
Strong heat stress	Hot	35.1-41.0
Extreme heat stress	Very hot	>41.0

4. Results

Results of the meteorological data involving a period from 1950 to 2019 obtained from the airbase meteorological measurement station in Erzurum are represented in Figure 3. According to the figure mean and averages of maximum and minimum PET values were found to be 5.5 ºC, 31.3 ºC and -23.9 ºC, respectively.

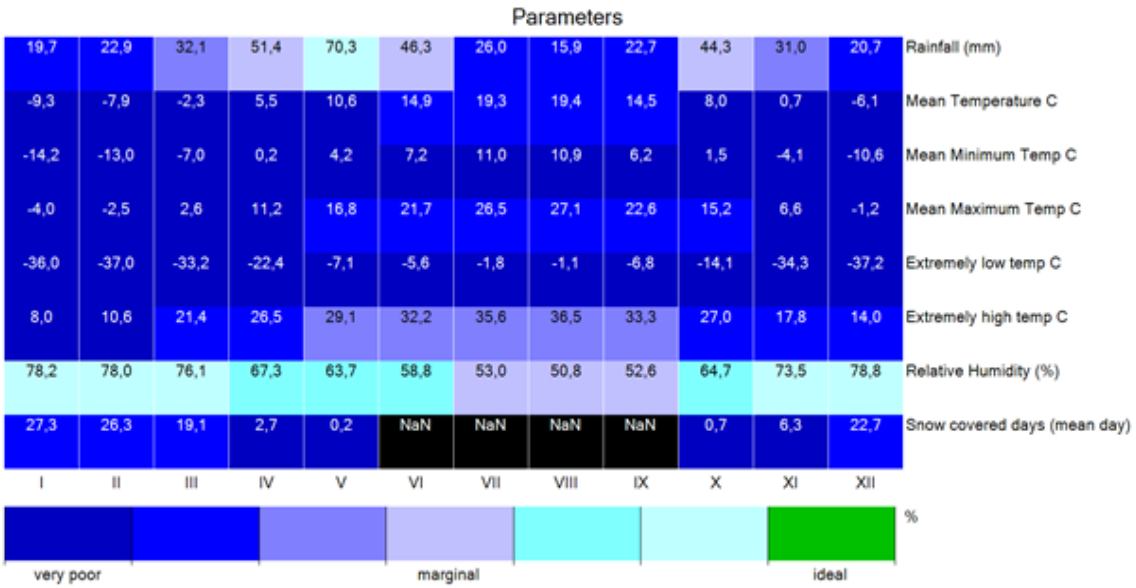
Figure 5. The situation of daily bioclimatic conditions (Source: Author)



It is stated when the results in Figure 5 are taken into consideration that comfortable and slightly warm ranges (18.1 – 23.0 and 23.1 – 29.0) can be tolerable from 120th day to 260th day by offering a thermally mild outdoor environment for especially summer activities from biking, hiking, trekking to water sports and sportive camping.

Climatic parameters which can reveal the suitability of the destination for tourism types other than bioclimatic analysis are given in Figure 6. Mean values of the parameters can be used for the comparison of the potentials of destinations while minimum, maximum and extreme values can be used to draw limitations of the destinations for the present and future tourism activities.

Figure 6. Assessment of climatic features for tourism (Source: Author)



It can be stated from Figure 6 that precipitation is problematic in some situations for summer activities. In several other indices, relative humidity is used in the combination with temperature to reveal the thermal conditions of tourists but the index used in the study uses PET for the detailed assessment of the thermal environment. This index is strong for the determination of the suitability of the destinations for tourism types therefore the study area seems to be proper for all types of summer activities except for 3 –S tourism. For winter tourism, the number of snow-covered days is the vital parameter in this respect, the situation of the destination is in a very good position but maybe the threshold value, at least 10 cm, can be analysed in more detail in the period from late October to early April.

5. Discussion and Conclusion

The results of bioclimatic comfort studies are now used more widely than ever before by expanding their fields from all types of sportive events and camping (Toy & Eymirli 2012; Toy & Matzarakis 2017) to spatial planning (Toy et al. 2018; Toy et al. 2019). Bioclimatological research conducted on tourism services for the determination of a destination's suitability for the tourism types performed (e.g. Matzarakis et al., 2005 for Crete, Greece; Matzarakis, 2007 for Heraklion; Greece and Matzarakis & Karagulle, 2007 for Istanbul, Turkey; Toy & Yilmaz (2017) for Erzincan, Kovacs et al. (2017) for all Hungary).

The present study assesses climate characteristics of a winter tourism destination considering a period from 1950 to 2019 including the analysis of bioclimatic comfort conditions. Based on the results, during the winter tourism season very cold (extremely cold) sensation is dominant for the period between October and May. In addition, in the warm summer period, the area also allows different types of outdoor activities.

Due to keen rivalry in the tourism sector all over the world depending on the importance of the tourism sector on the local economies, every destination struggles to make them attractive for tourists. In this respect, climatic elements function not only as supporting and potentials for diverse tourism types but also correspond to unique characteristics of a destination. This study is important to show the climatic characteristics of a winter tourism destination to be suitable for tourism activities. Despite the negative effects of climate change on all tourism activities the studies showing the advantage of the climatic characteristics of destinations are crucial for tourism development. Turkey getting one of the largest shares from tourism revenues all over the world targets further development of tourism in the close and remote future. As well as mass tourism the country also adopts alternative types of tourism. In this respect, both natural and man-made touristic values are utilised as assets. Climate is one of the main advantages provided by natural values in the country in especially its eastern part, i.e. study area. For both today and in the future, Turkey needs its tourism climate index and studies proposing such indices.

This study and similar studies are important, because Turkey gives priority to tourism development from regional to national bases, and is trying to create alternative tourism in its untouched parts. Such studies show that these possible tourism areas also have suitable climatic characteristics, in addition to having tourism potentials. After the

constitution of infrastructure for suitable tourism types, massive and aggressive advertisement challenges may be performed to attract tourists' attention.

Climate change increases the importance of climate information towards tourism by directing researchers to produce practically usable indicators derived from some indices based on more than one meteorological parameter. In addition, both the assessment of the present situation and the development of prospects are vital issues for the tourism sector to foresee if the climatic characteristics can improve or confine an area for tourism potentials. Climate indices need to help users to take concrete measures, draw their future projections, compare their destinations' results with those of others to contribute to the branding of the destinations. In this respect, rather than using a few climatic parameters indices should make a detailed analysis both for tourist satisfaction and tourism potentials of a destination. The index used in the study, CTIS, is not only easily understandable but also enables to analyse of every parameter needed for a destination.

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