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Research Article

Temperature Changes of Niğde Province in Turkey: Trend analysis of 50 years data

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This research was carried out in center of Niğde province and Ulukışla district in Turkey. In the study, monthly minimum, maximum and average temperature data between 1970-2019 were evaluated. In the research, Sperman's Rho and Mann-Kendall correlation tests and Sen's slope method were applied to temperature data. According to the results of the research, it has been observed that the average minimum temperature for many years was -1,2 °C in center of Niğde province and -2,9 °C in Ulukışla district. Average temperature values were found as 12,8 °C in Center of Niğde and 9,8 °C in Ulukışla district. The average of maximum temperature was found to be 24,5 °C in Niğde Center and 23,1 °C in Ulukışla district. A significant increase was observed in the spring, summer and autumn seasons in center of Niğde and Ulukışla district at minimum temperature values. When the average temperature trends were analyzed, it was determined that there was a significant increase in center of Niğde for every season. A significant increase in summer, autumn and winter seasons was observed in Ulukışla district. It had been determined that there was a significant increase in the maximum temperatures in each district in every season.

Key words: Temperature Changes, Global Warming, Trend Analysis, Nigde province, Turkey

INTRODUCTION

The climate should not be confused with the weather, known as atmospheric conditions, which are effective in a certain place and in a short time. Climate and weather are different things; The most important difference between them is the large region mentioned in time. The long years in the description of climate mean long cycles like 300-500 years. At least 30 years of observation records are needed to determine the climate conditions of a place with short-term primary evaluations. It should be noted that the 30-year period is a very short period of time besides the climate cycles (Yalçın et al., 2005).

The climate system tended to change naturally across all time scales from millions to decades throughout the Earth's nearly 4.5 billion years of history. The latest and most important natural climate changes, the effects of which are well known geomorphologically and climatologically, occurred during the glacier and interglacial periods in the 4th Time (Quaternary). However, since the middle of the 19th century, in addition to natural interchangeability, a new period has been entered for the first time, in which human activities affect the climate (Türkeş et al., 2000).

People have been interacting with the environment since the first age. Although this effect was very small at first, it did not attract the attention of human beings. Rapidly increasing human activity affects the environment negatively today. Especially since the industrial revolution, this effect has increased even more. A significant increase was observed in the amount of greenhouse gas emitted into the atmosphere with the industrialization. The world climate has been in constant and general change

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throughout all geological periods. Climate changes, which proceed in a natural line up to the industrial revolution, have taken place rapidly and seriously by human-induced factors with the increase in fossil fuel consumption after the industrial revolution (Bozyurt, 2002).

As the world seems to be an increase in the average temperature in Turkey. Especially in the western and southwestern parts, the tendency of warming increases. Due to the increase in urbanization, local climates occur in urban areas. Accordingly, the temperature differences between urban areas and rural areas increase and it is observed that the temperatures are higher in cities than their surroundings (Demir, 2008).

The most important of the greenhouse gases released into the atmosphere as a result of human activities, CO_2 concentrations have risen from 280 ppm to 382 ppm since the industrial revolution, as they show the dimensions of the danger (İncecik, 2007).

It is stated that the climate changes of the previous period are all caused by natural reasons; It can be said that the share of human activities that is irreversible is likely in the current and recent past climate changes. Short-range climate changes, which are claimed to occur as a result of human activities, are issues related to today's “global warming” phenomenon (Nişancı, 2007).

When the concentration of greenhouse gases in the atmosphere changes, the atmosphere content also changes. This increase brought with it the concept of global warming and global climate change. Global warming; While it expresses the systematic rise of temperature worldwide, global climate change is defined as the change of other climate elements such as precipitation, humidity, air movements and drought due to global warming (Çepel, 2003).

It has been explained how global warming poses a great danger to human life and other diversity of life. Temperature changes occurring on a global scale and these temperature changes have emerged by considering the measured and determined temperature values in recent years (Sağlam et al., 2008). The temperature on the earth's surface is determined by 4 factors; The amount of sunlight that the world receives, the amount of sunlight reflected by the world, keeping the temperature by the atmosphere, evaporation and concentration of water vapor (Aksay et al., 2005).

The idea of global climate change, expressed as the increase in global temperature and the change of precipitation pattern, has been accepted by scientists due to the findings obtained in recent years. (Karabulut and Cosun, 2009).

As a result of climate variations, vegetation and other existing natural resources are damaged. Especially these regions are areas where environmental problems such as drought and floods can occur. Emissions occurring in the climate can lead to other serious problems in these regions, such as different vegetation time, land degradation and reduced drought-related agricultural production. (Türkeş and Erlat, 2005)

As a result of the gradual warming of the atmosphere due to climate changes; It is estimated that the melting of glaciers and rising sea level, changing regional and local precipitation structures, increasing the number and frequency of extreme weather events, the disappearance of some animal and plant species due to the change of ecosystems, and increase of natural disasters related to climate such as flood, storm, hurricane and drought. (Bayraç and Doğan, 2016).

The effects of global climate change is having an impact on Turkey and Turkey's climate is considered to be in a change consistent with the global climate change (Önol and Semazz, 2009; Turkes and Sweet, 2011; Vardar et al, 2011).

Climate changes will create ecological, economic and sociological problems in many parts of the world over time. In one region of the world, there will be intense drought, temperature increase and fires, while in another region severe tornadoes, storms and floods will occur. The drought increase that may occur within the framework of climate changes; will have economic impacts such as decreased productivity of cultivated land, decreased product, insect infestation, plant diseases, low product quality, decline in livestock, forest fires and narrowed forest areas, and narrowed fish production areas. These effects will slow down the growth of the economy, increase credit risks, expensive water resources, increase unemployment in parallel with the decrease in production and cause losses in tax revenues (Gürer, 2007).

In another study similar to this research was conducted in Nevşehir province, which is 80 km away from Niğde province, evaluation of temperature data in long period based on global climate change was performed. In the study, the 50 years variations of the maximum, minimum and average temperature values of Nevşehir province, Avanos and Ürgüp districts were revealed. As a result of the study, it had been determined that there was an increasingly significant trend in temperatures (Bağdatlı and Arıkan, 2020).

In this study, the years of change in long-term minimum, average and maximum monthly temperature values of Niğde center and Ulukışla district between 1970-2019 have been examined. As a result of the study, the trend in temperature changes was revealed.

MATERIAL AND METHOD

Material

The study area was located in Central Anatolia Region, Center of Niğde province and Ulukışla district. The location and position of the examined districts within the scope of the research can be seen on the map given in Figure 1.

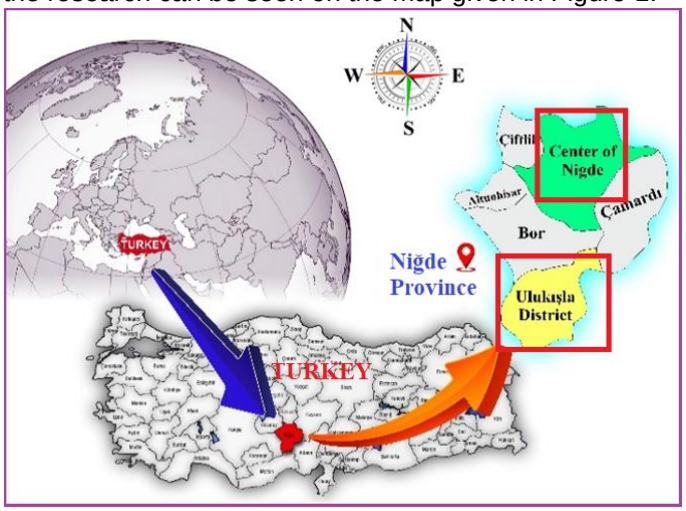

Figure 1. Location of districts examined in the research

Method

In the study, monthly changes of the temperature values observed between 1970 and 2019 of meteorology stations in the Niğde center and Ulukışla district were used. A total of 600 months were analyzed. The results of the analysis are statistically presented in graphs and charts. In the trend analysis, Sperman's Rho, Mann-Kendall and Sen's trend slope method were used. The analysis was carried out in the 95% confidence level (Mann 1945; Kendall 1975; Sen 1968). In the study, a software called "Trend Analysis for Windows", Mann-Kendall test, Spearman's Rho test, Mann-Kendall Order Correlation test and Sen's trend slope method are applied to the data and the result is given as graphics and text (Gümüş ve Yenigün 2006).

RESEARCH FINDINGS

Trend analysis results for the minimum, average and maximum temperature values between 1970-2019 for the center of Niğde and Ulukışla districts are presented in detail below.

The Changes of Minimum Temperature in 1970-2019 years

For many years, the minimum temperature values were analyzed in the seasons and the general averag. The results obtained and all evaluations were presented graphically. The distribution of Niğde center, minimum temperature values by years is given in the graphs in Figure 2.

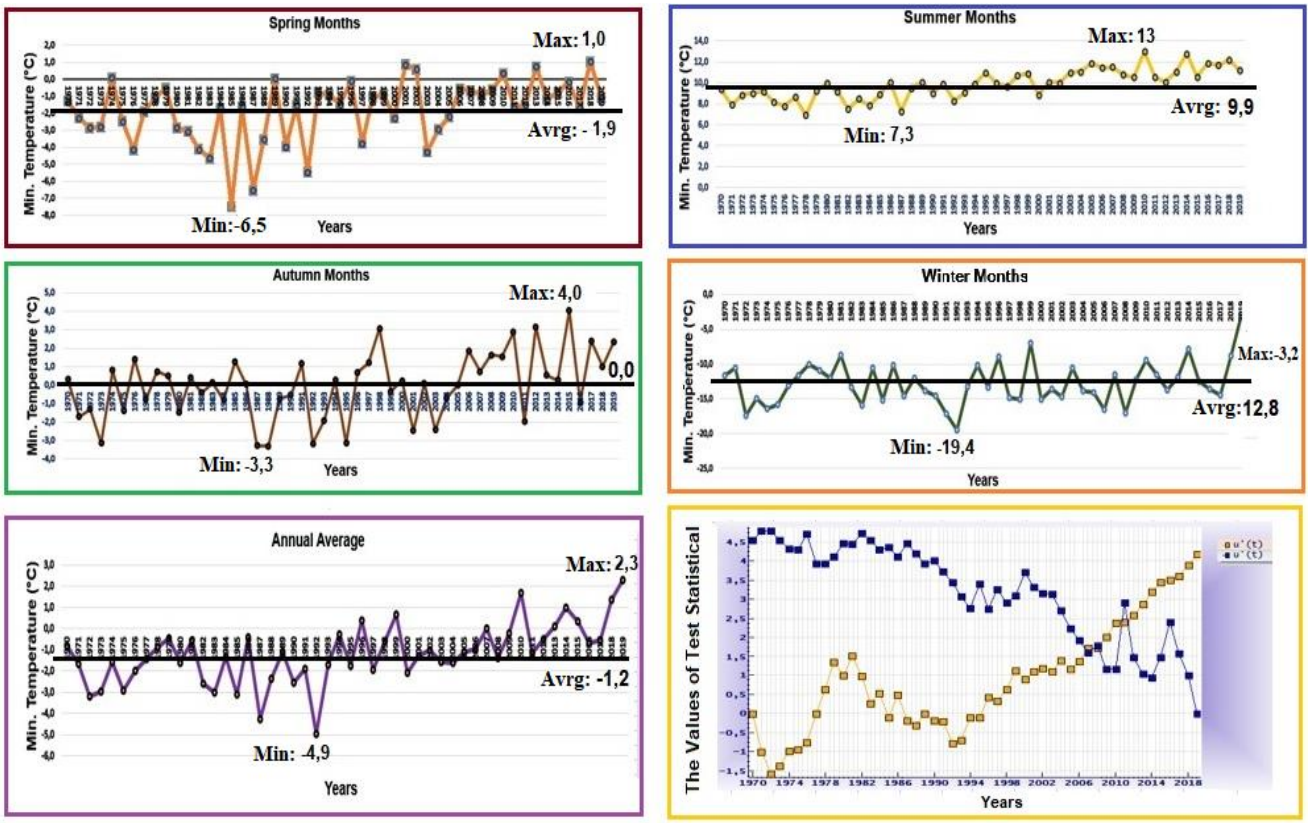

Figure 2. The Changes of Minimum temperature (°C) in Center of Niğde Province, (1970-2019)

In the spring, the highest value of the minimum temperature was observed as -0,2 °C in 2018 and the lowest temperature in 1987 with -7,8 °C. The average of minimum temperatures in spring month was -3,7 °C.

In summer months, the highest minimum temperature was determined in 2014 with 10,8 °C and the lowest minimum temperature in 1984 with 5,4 °C. The average of minimum temperatures in summer months were determined as 8,1 °C. The highest minimum temperature in autumn months were 2,8 °C in 2003, the lowest minimum temperature was in 1973 as -6,3 °C. The average of minimum temperatures in autumn months were found -1,6 °C. The highest minimum temperature in winter months were as -9,5 °C in 2014 and the lowest minimum temperature was -19,1 °C in 1992. The average of minimum temperatures in winter months were determined as -14,5 °C. In general average, the minimum temperature values for many years, the highest value was found in 1992 with the lowest value in 2010 and -5,7 °C in 2010. The long average minimum temperature for many years were -2,9 °C. The variation of the minimum temperature values of Ulukışla district by years is shown with the graphs in Figure 3.

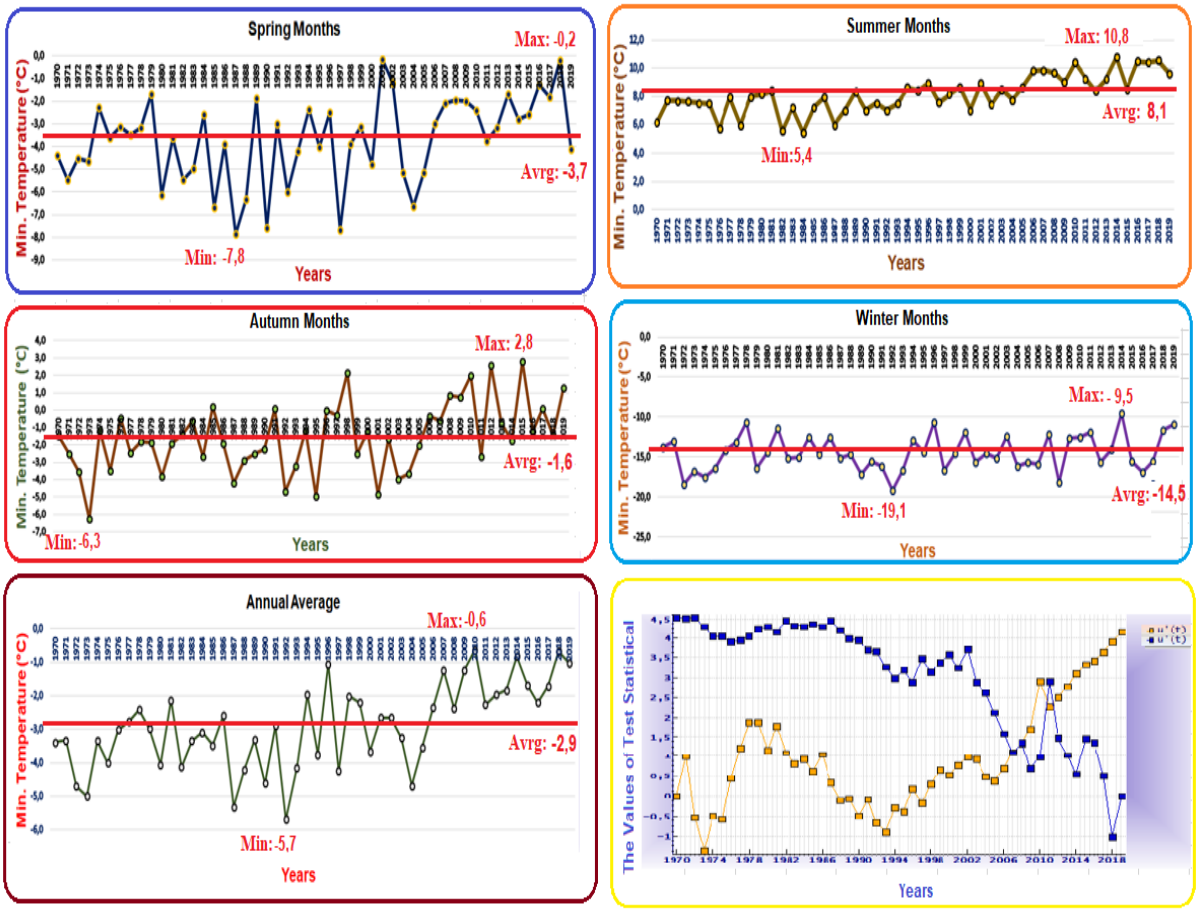

Figure 3. The Changes of Minimum temperature (°C) in Ulukışla district, (1970-2019)

The highest minimum temperature for spring months in Ulukışla district were 1,0 °C in 2018 and the lowest minimum temperature in 1987 with -6,5 °C. The average of minimum temperature in spring months were -1,9 °C.

The highest minimum temperature in summer months were determined as 13,0 ° C in 2010 and the lowest minimum temperature as 7,3 °C in 1987. The averages of minimum temperature in the summer months were found as 9,9 °C.

In autumn months, the highest value of the minimum temperature were 4,0 °C in 2015,the lowest minimum temperature value was -3,3 °C in 1987. The minimum temperature averages of autumn months were determined as 0,0 °C. The highest minimum temperature in winter months were -3,2 °C in 2019 and the lowest minimum temperature was -19,4 °C in 1992. The averages of minimum temperature were observed as -12,8 °C during the winter months. In general, it was observed that the highest minimum temperature value was 2,3 ° C in 2019 and the lowest minimum temperature was in 1992 with -4,9 °C. The general average of minimum temperatures in Ulukışla district was determined as -1,2 ° C. Minimum temperature trend analysis results for Niğde center and Ulukışla districts for many years, It is presented in Table 1.

Table 1. Trend analysis results of minimum temperature values of Niğde center and Ulukışla district

Provinces	Years / Data	Seasons	Mann-Kendall Test Statistical	Spearman's Rho Test Statistical
Center of Niğde	1970-2019 Min. Temperature °C	Spring Months	+	+
		Summer Months	+	+
		Autumn Months	+	+
		Winter Months	X	X
		General Average	+	+
Ulukisla District		Spring Months	+	+
		Summer Months	+	+
		Autumn Months	+	+
		Winter Months	X	X
		General Average	+	+

+ : Possitive Trend X : No Trend

Considering the trend analysis results of minimum temperature values of Niğde center and Ulukışla district; It had been observed that there was a significant increase only in the winter months in the center of Niğde and Ulukışla district. There was no significant trend in other seasons and overall average.

The Changes of Average Temperature in 1970-2019 years

Average temperature values for many years were analyzed in seasons and general average and all evaluations made in the results obtained were presented graphically. Graphical representation of the average temperature values in Center of Niğde for many years can be seen in Figure 4.

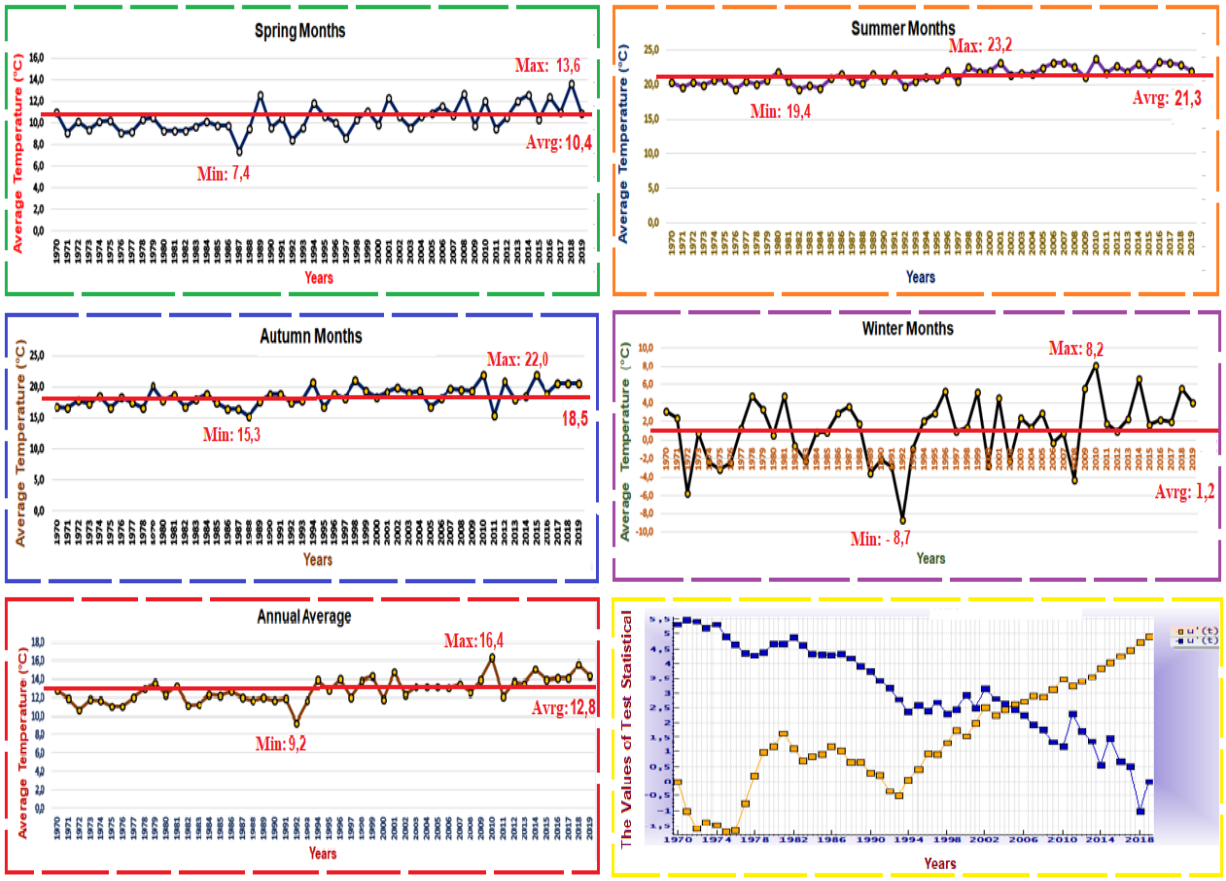

Figure 4. The Changes of Average Temperature (°C) in Niğde center, (1970-2019)

In spring months, the highest average temperature was observed 13,6 °C in 2018 and the lowest average temperature was 7,4 °C in 1987. The overall average of the average temperature changes in spring months were determined as
10,4 °C.

The highest average temperature in the summer months were 23,2 °C in 2001, the lowest average temperature was 19,4 °C in 1984, the general average of average temperatures was 21,3 °C.

In the autumn months, the highest average temperature value was 22,0 °C in 2015, the lowest 15,3 °C in 1988, and the average of average temperature was 18,5 °C.

It was observed that the highest average temperature in winter months were 8,2 °C in 2010 and the lowest average temperature in 1992 with -8,7 °C. The overall average of the average temperatures for long years was determined as 1,2 °C.

According to the general average temperature values for many years, the highest general average temperature value was determined in 1992 with 16,4 °C and the lowest value in 2010 with 9,2 °C. General average was 12,8 °C.

The changes in the average temperature values in Ulukışla district for years are shown in detail in the graphs in Figure 5.

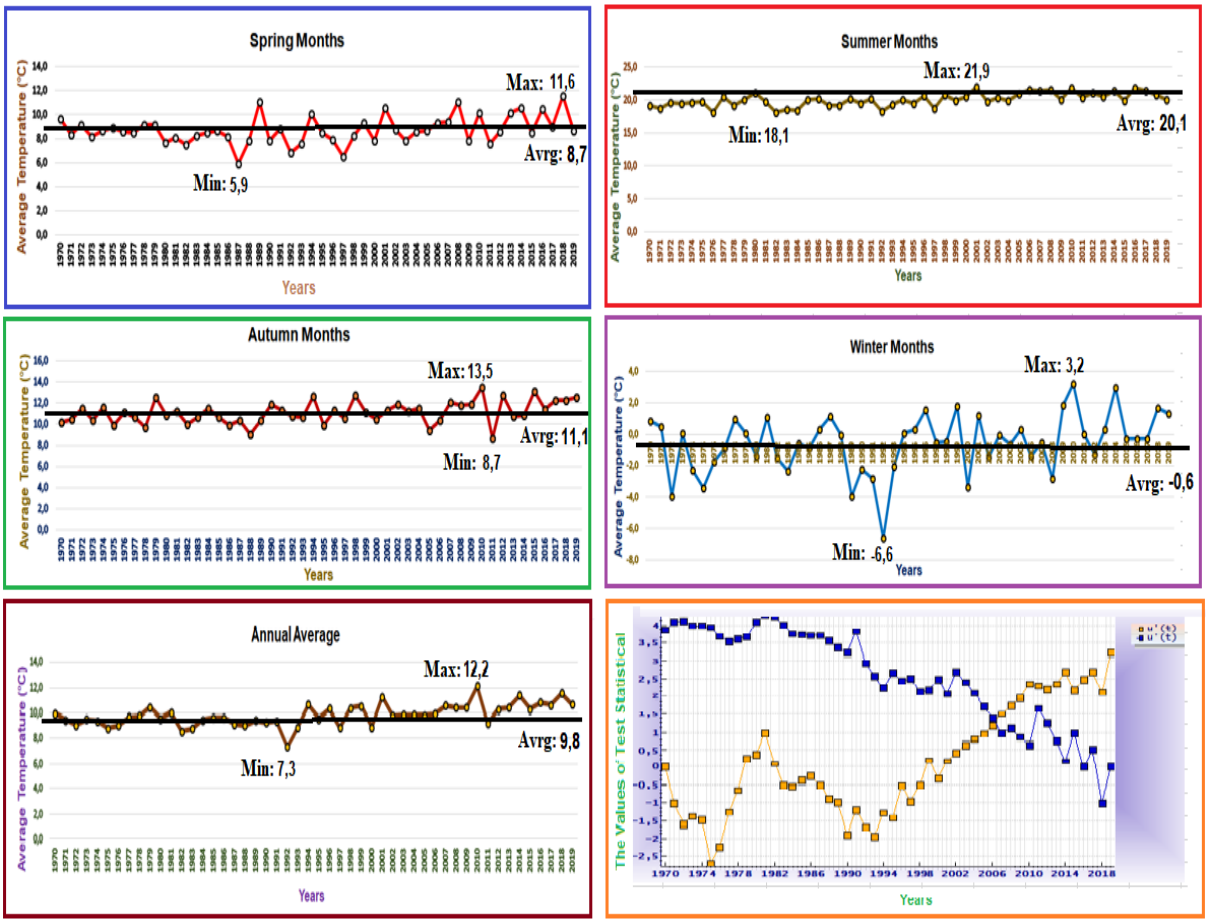

Figure 5. The Changes of Average Temperature (°C) in Ulukışla district, (1970-2019)

In the spring months, the highest average temperature was 11,6 °C in 2018, the lowest average temperature was 5,9 ° C in 1987 and the mean of average temperatures was 8,7 °C.

In the summer months, the highest average temperature was 21,9 °C in 2001, the lowest average temperature was 18,1 °C in 1982 and the general mean of average temperatures was 20,1 °C.

In the autumn months, the highest average temperature value was 13,5 °C in 2010 and the lowest average temperature was 8,7 °C in 2011, the general mean of the average temperature was 11,1 °C.

The highest average temperature in winter months were 3,2 °C in 2010, the lowest was -6,6 °C in 1992 and the general mean of the average temperatures was -0,6 °C.

Considering the annual average values, it was observed that the highest average temperature value was 12,2 °C in 2010 and the lowest average temperature value was 7,3 °C in 1992. General mean of the average temperature for many years was 9,8 °C.

Trend analysis results of average temperature values of Niğde center and Ulukışla district for long years are given in Figure 6.

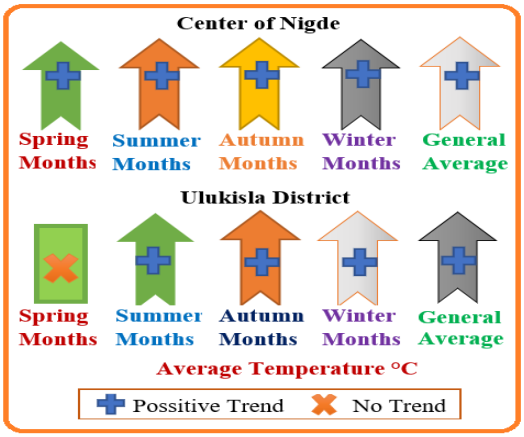

Figure 3.5. Trend analysis results of average temperature values for center of Niğde and Ulukışla districts in 1970-2019

Considering the trend analysis results of average temperature values of Niğde center and Ulukışla district; It was observed that there is a significant trend in Niğde center in all seasons. In Ulukışla district, it was observed that there was a significant trend in all seasons except spring months.

The Changes of Maximum Temperature (°C) in 1970-2019 years

For many years, the maximum temperature values were seasonally analyzed and all evaluations were presented as graphically. The changes of the maximum temperature values in Niğde center for years are shown in Figure 7.

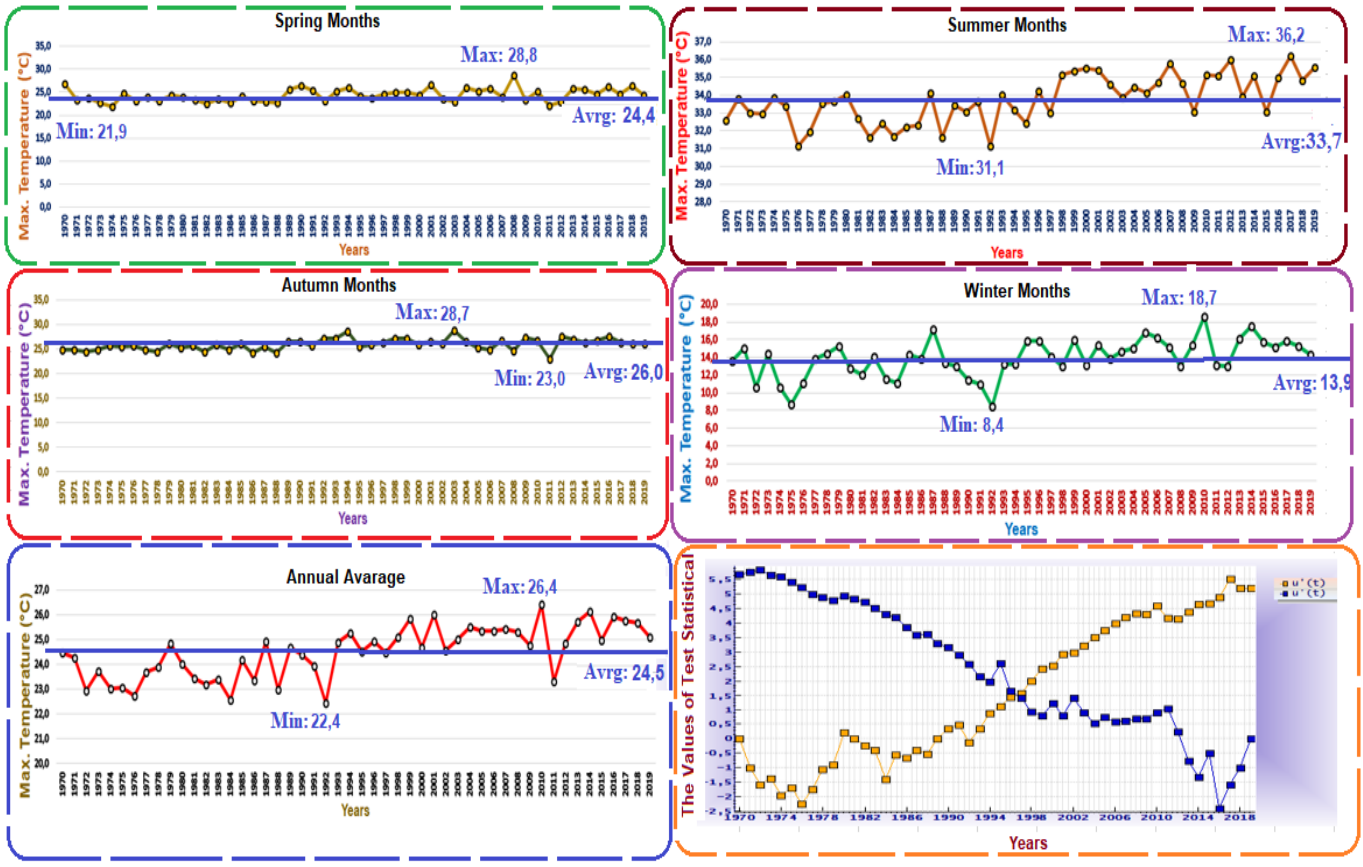

Figure 7. The Changes of Maximum Temperature (°C) in Center of Niğde, (1970-2019)

In spring months, the highest maximum temperature was 28,8 °C in 2008, the lowest temperature was 21,9 °C in 1974 and the average maximum temperature was 24,4 °C.

In summer months, the highest value of the maximum temperature was 36,2 °C in 2017, the lowest maximum temperature was 31,1 °C in 1992 and the average of the maximum temperature was 33,7 °C.

In autumn months, the highest maximum temperature was 28,7 °C in 2003, the lowest maximum temperature was 23,0 °C in 2011, the average of the maximum temperature was 26,0 °C.

In winter months, the highest maximum temperature was 18,7 °C in 2010, the lowest maximum temperature was 8,4 °C in 1975 and the average of the maximum temperature was 13,9 °C. Looking at the average of the maximum temperature for many years; The highest maximum temperature value was observed in 2010 as 26,4 °C and the lowest maximum temperaturen was 22,4 °C in 2000, The general average of the maximum temperatures was 24,5 °C.

The distribution of the maximum temperature values in Ulukışla district for long years is shown in the graphs given in Figure 8.

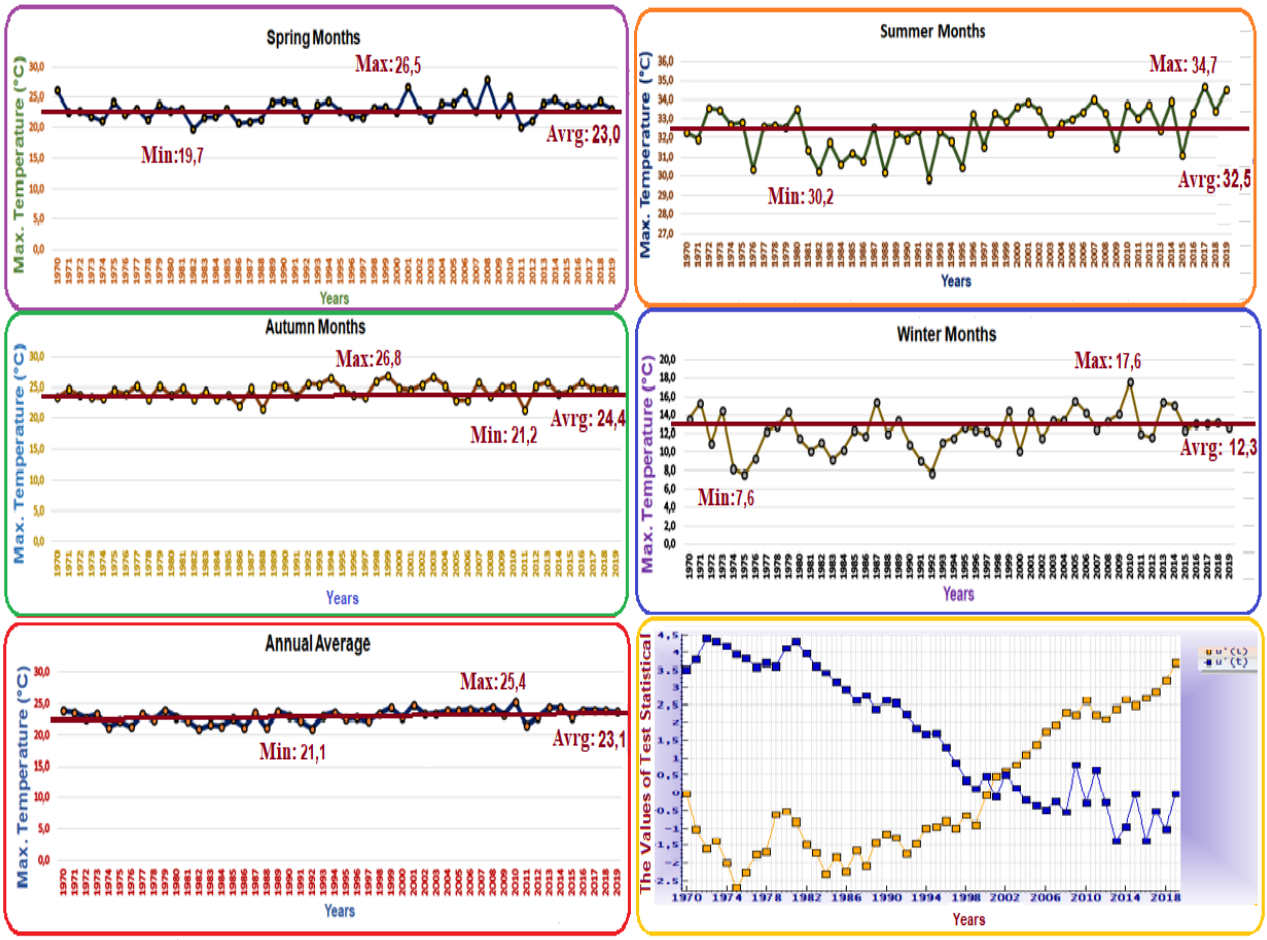

Figure 8. The Changes of Maximum Temperature (°C) in Ulukışla District, (1970-2019)

In spring months, the maximum maximum temperature was 26,5 °C in 2001, while the lowest maximum temperature was 19,7 °C in 1982, the average maximum temperature was 23,0 °C.

In summer, the highest maximum temperature was 34,7 °C in 2017, the lowest maximum temperature was 30,2 °C in 1982, the average maximum temperature was 32,5 °C.

The highest maximum temperature in the autumn months were 26,8 °C in 1999, the lowest maximum temperature was 21,2 °C in 2011, the average maximum temperature was 24,4 °C.

In winter months, the highest maximum temperature was 17,6 °C in 2010, the lowest maximum temperature was 7,6 °C in 1975, the average maximum temperature was 12,3 °C.

According to average maximum temperature changes over many years; The highest average value of the maximum temperatures was 25,4 °C in 2010 and the lowest value was in 2000 with 22,8 °C. The general average of the maximum temperatures was 23,1 °C.

Trend analysis results of maximum temperature values of Niğde center and Ulukışla district for long years are summarized in Figure 9.

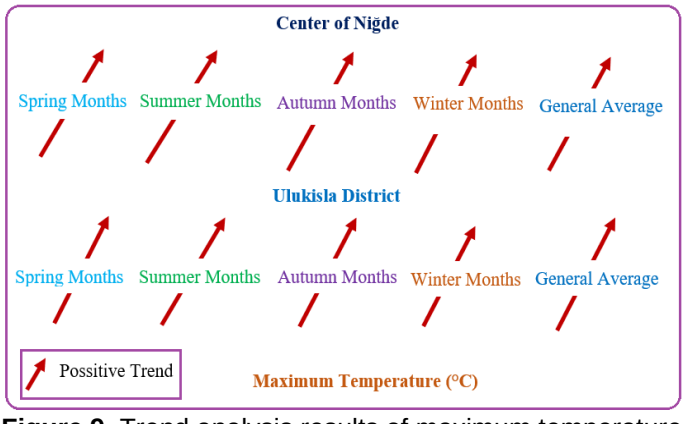

Figure 9. Trend analysis results of maximum temperature values in Center of Niğde and Ulukışla district for many years (1970-2019)

Considering the trend analysis results of the maximum temperature values of Niğde center and Ulukışla districts; It was concluded that there was a significant trend in the maximum temperature changes for many years across all seasons.

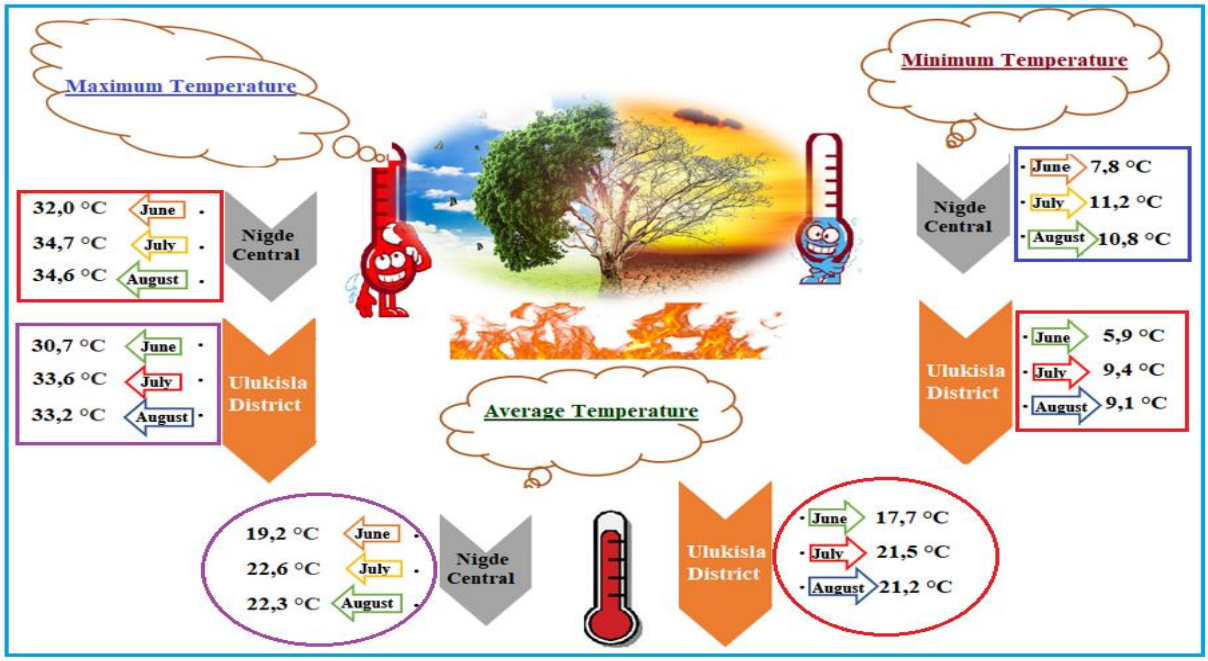

Figure 10. General averages of minimum, average and maximum temperatures in Summer months of Niğde center and Ulukışla district

CONCLUSION AND SUGGESTIONS

Minimum, average and maximum temperature values for Niğde Center and Ulukışla district in long years (1970-2019) were analyzed for 50 years and 600 months in total. In study, Its change over the years was determined by trend analysis. Trend Analysis results of maximum, minimum and average temperature values for many years in June, July and August are summarized in Figure 10.

Considering the average maximum temperatures in summer months; In the center of Niğde, 32,0 ^{o}C for June, 34,7 ^{o}C for July and 34,6 ^{o}C for August. In Ulukışla district, it was calculated as 30.7 ^{o}C in June, 33,6 ^{o}C in July and 33,2 ^{o}C in August.

According to the averages of the minimum temperatures; In the center of Niğde, 7,8 ^{o}C in June, 11,2 ^{o}C in July and 10,8 ^{o}C in August. In Ulukışla district, it was determined as 5,9 ^{o}C in June, 9,4 ^{o}C in July and 9,1 ^{o}C in August.

Considering the change of average temperatures in the summer months; The average temperature value for June in the center of Niğde was 19,2 ^{o}C in June, 22,6 ^{o}C in July and 22,3 ^{o}C in August. In the Ulukışla district, it was observed that there was 17,7 ^{o}C in June, 21,5 ^{o}C in July and 21,2 ^{o}C in August.

When we look at the results of all seasons trend analysis in Niğde center and Ulukışla districts at minimum, average and maximum temperature changes; It has been observed that there is no significant increase in minimum temperatures in the center of Niğde center and Ulukışla districts during the winter months. However, a significant increase was observed in the spring, summer and autumn seasons and the general average. It was determined that there was a significant increase in the average temperature values in the center of Niğde in every season. In Ulukışla district, there was no significant change in the spring season. However, it was calculated that there was a significant increase in winter, summer and autumn seasons and the general average. According to the maximum temperature data, it has been determined that there is a significant increase in all seasons in center of Niğde and Ulukışla district.

In another study similar to this study, temperature changes in Nevşehir province were evaluated for many years. Overall average of long annual minimum temperature values. It was determined as -2,64 ^{0}C. The overall average of the maximum temperature values were determined as 24,54 ^{0}C. The general mean of the average temperatures were observed as 11 ^{0}C. There was a significant increase in maximum, minimum and average temperature changes in the Nevşehir province (Bağdatlı and Arıkan, 2020).

Excessive increase and decrease of temperatures negatively affect the life of living things. It will be difficult to find clean water in the future as the increase of temperatures will increase the evaporation level. Increasing or falling temperatures will cause climate change. With the change of climates, many creatures are likely to face the threat of extinction. As the temperature rises, the glaciers at the poles melt and the sea level increases proportionally. Another reason that causes the temperature to increase is the greenhouse effect. Taking measures to reduce carbon emissions is a measure that can reduce this effect. In this sense, reducing the effects that will keep the temperature change to a minimum will reduce the effect of the temperature on the environment, agriculture and human health.

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