



**THE ANALYSIS OF SOIL TEMPERATURES IN DIFFERENT DEPTHS
USING SPEARMAN'S RHO AND MANN-KENDALL CORRELATION
TESTS: THE CASE STUDY OF NIGDE CENTER IN TURKEY**

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Abstract:

This research was conducted to determine soil temperatures in different soil depths in located Turkey's Anatolia Region in Center of Nigde Province. In the study, the maximum, minimum and average soil temperature values of 10 cm, 50 cm and 100 cm depths observed between 1970-2019 were examined. All soil temperature data were evaluated monthly within the scope of the study. In the study, Mann-Kendall, Sperman's Rho correlation test and Sen's slope method were used. According to the research result; The average of maximum soil temperatures in 10 cm depth was calculated as 6,8 0C in winter months and 20,7 0C in spring months. The average minimum soil temperature was calculated as 0,3 0C in winter and 5,0 0C in spring Months in long periods Generally, it was observed that there was an increasingly significant trend at maximum temperatures of 10 cm depth. According to the Mann-Kendal facility, a significant increase trend was observed in minimum soil temperatures in spring, winter and Summer months except for the months of autumn. Considering the average maximum temperature values in 50 cm; It was calculated as 6,6 °C in winter and 13,6 °C in spring months. The minimum soil temperature average was calculated as 3,5 0C in winter and 8,3 0C in spring months in long period (50 year, 600 months). In general, it was observed that there was an increasingly significant trend at maximum temperatures of 50 cm soil depth. According to Mann-Kendall and Sperman Rho test, a significant increase trend was observed in minimum soil temperatures in all seasons except for autumn months. According to the average maximum temperature values in 100 cm depth; It was calculated as 9,2 0C in winter and 11,5 0C in spring. The minimum soil temperature average was calculated as 7,1 0C in winter and 8.7 0C in spring months. It has been observed that there is a significant increase trend in the increasing of maximum and minimum soil temperatures of 100 cm soil depth.

Keywords: Soil Temperatures; Trend Analysis; Center of Nigde Province; Turkey.

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1. Introduction

Global warming is defined as the increase of the average world temperature naturally or by human influence in parts of the atmosphere close to the earth's surface [1]. Soil temperature is one of the factors that significantly affect soil formation processes, the severity of chemical, physical, biochemical and biological changes, plant growth and development.

The change in soil temperature also affects the soil's water balance, nitrogen conversion and thermo-physical properties. High yield in crop production depends on optimum soil temperature. Such as soil temperature, soil properties (volume weight, moisture, presence of organic layer on the surface, groundwater height, soil color, etc.), topography (degree of slope, direction, height, etc.) and climatic properties (precipitation, wind, pressure, etc.) it is under the influence of many environmental factors [2].

Soil temperature depends on the structure of the soil, climatic conditions, vegetation, etc. depending on the thermal diffusion along the soil profile differs [3].

Global climate change manifests itself in negative dimensions in all areas. It is under the threat of World Climate change with the increase of carbon emission and greenhouse gas effect. Carbon is one of the basic elements of life. However, the gradual increase in the amount of CO₂ in the atmosphere depending on human needs and consumption decreases the protective effect of the bard layer and also causes irregularities in the precipitation along with the temperature. Studies show that the temperature will increase 0,1 °C every ten years [4].

In this study, it was carried out with the purpose of trending analysis of the changes in terms of years, the maximum, minimum and average soil temperature values of 10 cm, 50 cm and 100 cm soil depths observed in Nigde Center between 1970-2019 and revealing the increase or decrease tendencies.

2. Materials and Methods

The study area is located in the center of Nigde, Anatolia region of Turkey. In the study, the maximum, average and minimum soil temperature 10 cm, 50 cm and 100 cm soil depths values of the 1970-2019. Niğde Center climate observation station's datas were used as materials in the study. The location and position of the Nigde Center subject to the research can be seen on the map given in Figure 1.



Figure 1: Location and position of the Research Area

In the study, Soil temperature values changes in 10, 50, 100 cm soil depths monthly observed in Nigde Central meteorology station between 1970-2019 were used [5]. A total of 600 months were analyzed. In the research, changes in values measured at maximum, average and minimum soil temperatures 10 cm, 50 cm and 100 cm for many years were subjected to trend analysis. In this sense, in order to evaluate the data, it was evaluated within the scope of Rho Kendall Test of Mann Kendall and Spearman's Rho test and Sen's slope method and it was done in the 95% confidence level [6, 7, 8].

In the research, a software called "Trend Analysis for Windows", Mann-Kendall test, Spearman's Rho test, Mann-Kendall Order Correlation test and Sen's slope method are applied to the data and the result is graphical and text [9].

3. Research Results

The trend analysis results of the Nigde Center for the years between 1970-2019 regarding maximum, average and minimum soil temperature values of 10 cm, 50 cm and 100 cm soil depths are presented in detail below.

3.1. Changes of Maximum Soil Temperatures at 10 cm Soil Depth

Nigde Center which has been subjected to analysis for many years (1970-2019), has been evaluated seasonally (spring, autumn, summer and winter months) with a maximum soil temperature values. The changes in the maximum soil temperature values of 10 cm depth for many years are also shown in detail in the graph given in Figure 2.

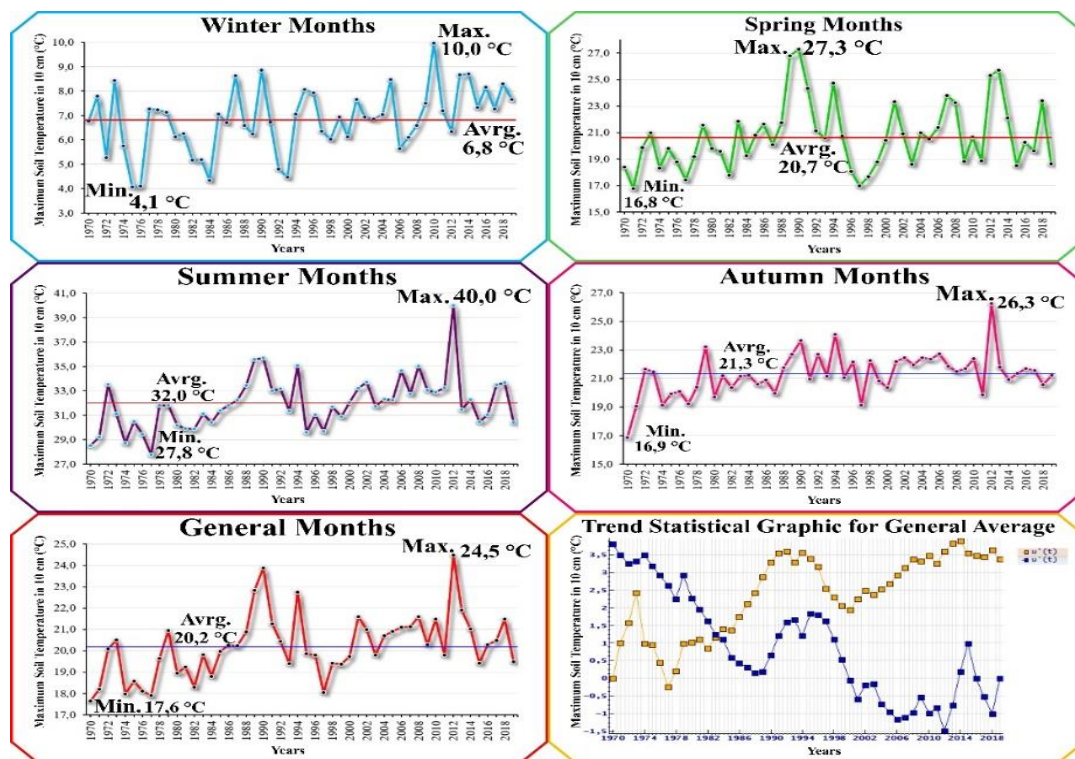










Figure 2: Changes in Maximum Soil Temperature at 10 cm Soil Depth

It has been found to have the highest soil temperature values of 10,0 °C in 2010, the lowest soil temperature of 4,1 °C in 1975 and the average soil temperature of 6,8 °C in winter months for 10 cm soil depth. The highest value in the spring months was 27,3 °C in 1991 and the lowest soil temperature was 16,8 °C in 1971. In spring, the maximum soil temperature average of 10 cm soil depth was recorded as 20,7 °C. The highest for summer months was 40,0 °C in 2012 and the lowest soil temperature was 27,8 °C in 1977. In summer months, the maximum soil temperature average of 10 cm depth was observed as 32,0 °C. The highest in 10 cm depth maximum soil temperature for autumn months is 26,3 °C in 2012, the lowest soil temperature is 16,9 °C in 1970 and the average soil temperature is 21,3 °C.

According to the general average for many years; The highest soil temperature was recorded as 24,5 °C in 2012, the lowest soil temperature as 17,6 °C in 1970 and the average maximum soil temperature as 20,2 °C. Seasonal trend analysis results of maximum soil temperature values at 10 cm soil depth are shown in Table 1.

Table 1: Trend Analysis Results of Maximum Soil Temperatures at 10 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman'in Rho Test Statistical
Maximum Soil Temperature in 10 cm	Spring	No Trend →→	No Trend →→
	Winter	Positive Trend 	Positive Trend 
	Autumn	Positive Trend 	Positive Trend 
	Summer	Positive Trend 	Positive Trend 
	General Average	Positive Trend 	Positive Trend 

According to the results of the trend analysis, it has been observed that there is an increasing trend in the mean of spring, summer, autumn and general average except for spring months.

3.2. Changes in Maximum Soil Temperatures at 50 cm Soil Depth

Maximum soil temperature values at 50 cm soil depth were evaluated seasonally (spring, autumn, summer and winter months) with trend analysis. The variation of the maximum soil temperature values for 50 cm soil depth by long period (50 year) is shown in detail in the graph given in Figure 3.

According to the maximum soil temperature values at 50 cm soil depth; the highest was 9,0 °C in 2011, the lowest soil temperature was 3,9 °C in 1992 and the average maximum soil temperature was 6,6 °C.

The maximum soil temperature of 50 cm soil depth in the spring months was calculated as 20,0 °C in 2013 and the lowest soil temperature in 1980 was 11,2 °C. In spring months, the maximum soil temperature average value was recorded as 13,6 °C.

The highest soil temperature for the summer months was 29,8 °C in 2013, the lowest soil temperature was 22,3 °C in 1977, and the maximum soil temperature average for the summer months was 24,4 °C.

Maximum soil temperature at the highest 50 cm soil depth for autumn months was found to be 21,1 °C in 2010. The lowest soil temperature is 17,4 °C in 1970 and the average soil temperature is 19,1 °C. According to the general average of all seasons 50 cm soil depth; The maximum soil temperature change was recorded as 19,5 °C in 2013, the lowest in 14,4 °C in 1992 and the average soil temperature as 15,9 °C.

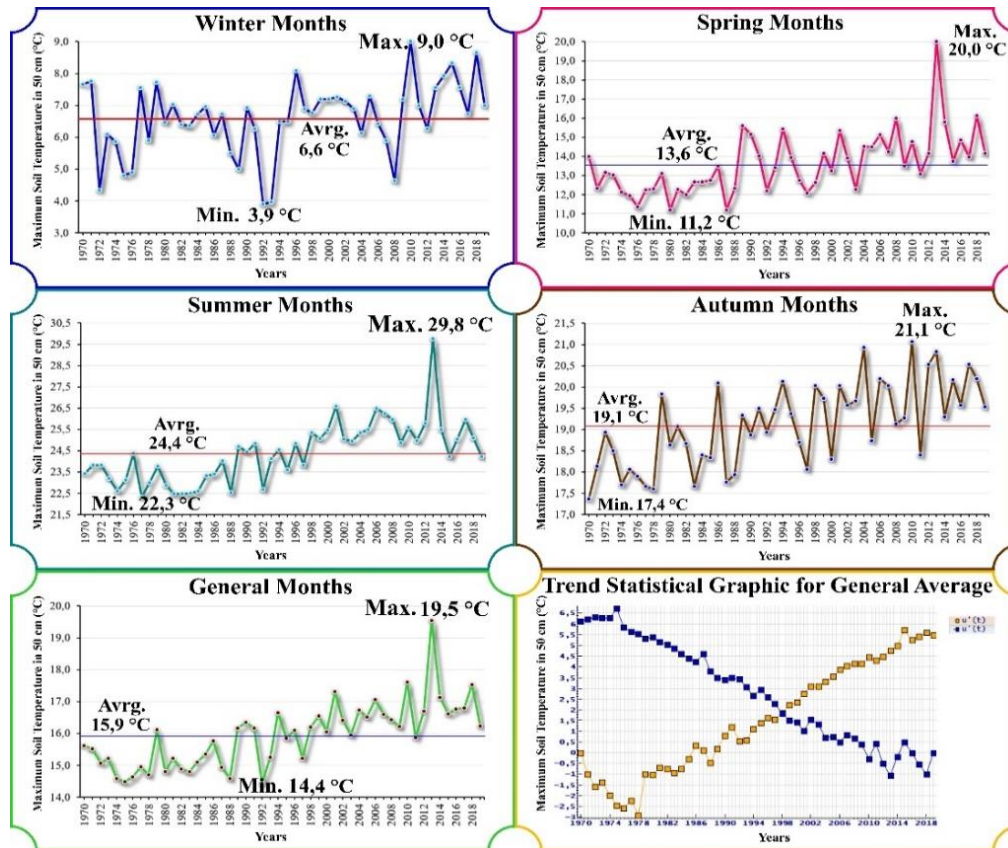


Figure 3: Changes of Maximum Soil Temperature at 50 cm Soil Depth

Maximum soil temperature values at 50 cm soil depth are seasonally tested for trend analysis. The test results are shown in the table given in Table 2.

Table 2: Trend Analysis Results of Maximum Soil Temperatures at 50 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman'in Rho Test Statistical
Maximum Soil Temperature in 50 cm	Spring	Positive Trend	Positive Trend
	Winter	Positive Trend	Positive Trend
	Autumn	Positive Trend	Positive Trend
	Summer	Positive Trend	Positive Trend
	General Average	Positive Trend	Positive Trend

According to the results of the trend analysis, it was observed that there was an increasingly significant trend in the spring, summer, autumn, winter and general average.

3.3. Changes of Maximum Soil Temperatures at 100 cm Soil Depth

For long years (1970-2019), maximum soil temperature values at 100 cm soil depth were evaluated seasonally (spring, autumn, summer and winter months) by trend analysis. The change in the maximum soil temperature values at 100 cm soil depth for many years is also shown in detail in the graphic given in Figure 4.

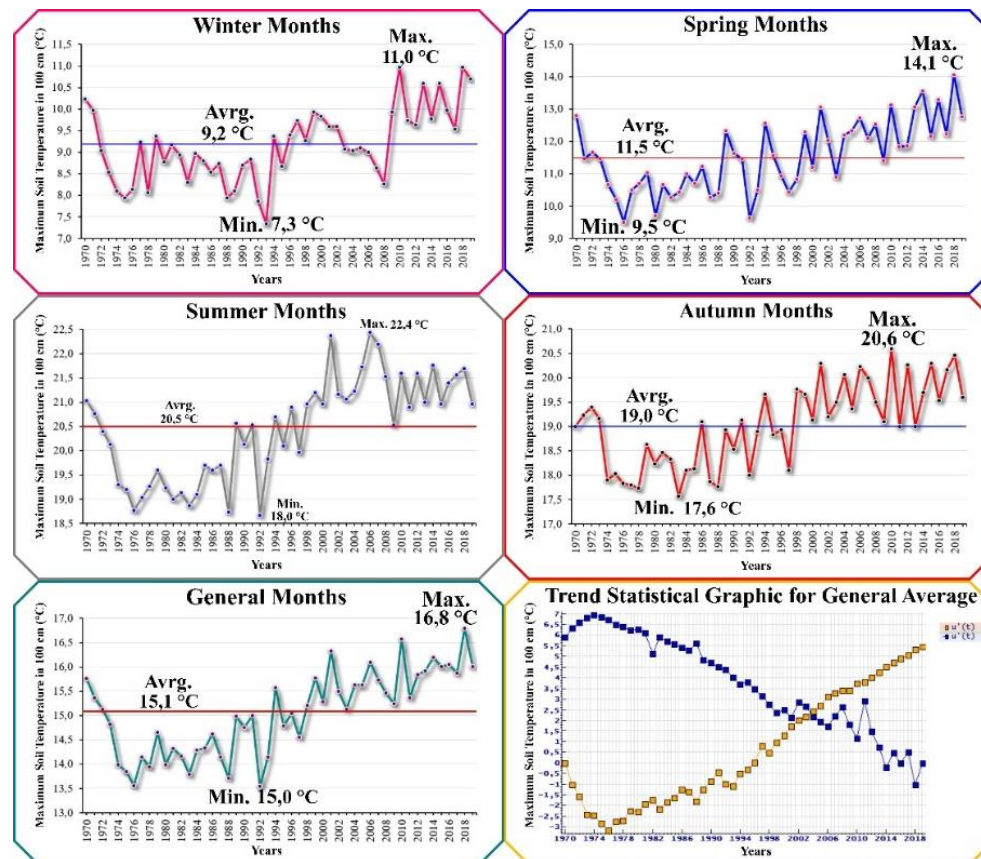












Figure 4: Changes in Maximum Soil Temperature at 100 cm Soil Depth

The maximum soil temperature values at a depth of 100 cm depth were found to be 11,0 °C in 2010, the lowest soil temperature in 1993 and 7,3 °C in 1993 and an average soil temperature of 9,2 °C. The highest soil temperature was calculated as 14,1 °C in 2018 and the lowest soil temperature as 9,5 °C in 1976.

In spring, the maximum soil temperature average value at a soil depth of 100 cm was recorded as 11,5 °C. The highest soil temperature was 22,4 °C in 2007, the lowest soil temperature was 18,0 °C in 1992 and the maximum soil temperature was 20,5 °C in 1992.

The highest 100 cm maximum soil temperature for autumn months is 20,6 °C in 2011, the lowest soil temperature is 17,6 °C in 1983 and the average soil temperature is 19,0 °C. The overall average of all seasons was 16,8 °C in 2018, the lowest temperature was 15,0 °C in 1992 and the average soil temperature was 15,1 °C. The maximum soil temperature values of 100 cm depth were seasonal trend analysis test results are given in Table 3.

Table 3: Trend Analysis Results of Maximum Soil Temperatures at 100 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman'in Rho Test Statistical
Maximum Soil Temperature in 100 cm	Spring	Positive Trend 	Positive Trend 
	Winter	Positive Trend 	Positive Trend 
	Autumn	Positive Trend 	Positive Trend 
	Summer	Positive Trend 	Positive Trend 
	General Average	Positive Trend 	Positive Trend 

According to the trend analysis results, it has been observed that there is an increasing trend on the basis of spring, summer, autumn, winter and general average.

3.4. Changes in Average Soil Temperature at 10 cm Soil Depth

Average soil temperature values of 10 cm soil depth were evaluated seasonally (spring, autumn, summer and winter months) with trend analysis between 1970-2019. The change in the average soil temperature values of 10 cm depth is shown in detail in the graph given in Figure 5.

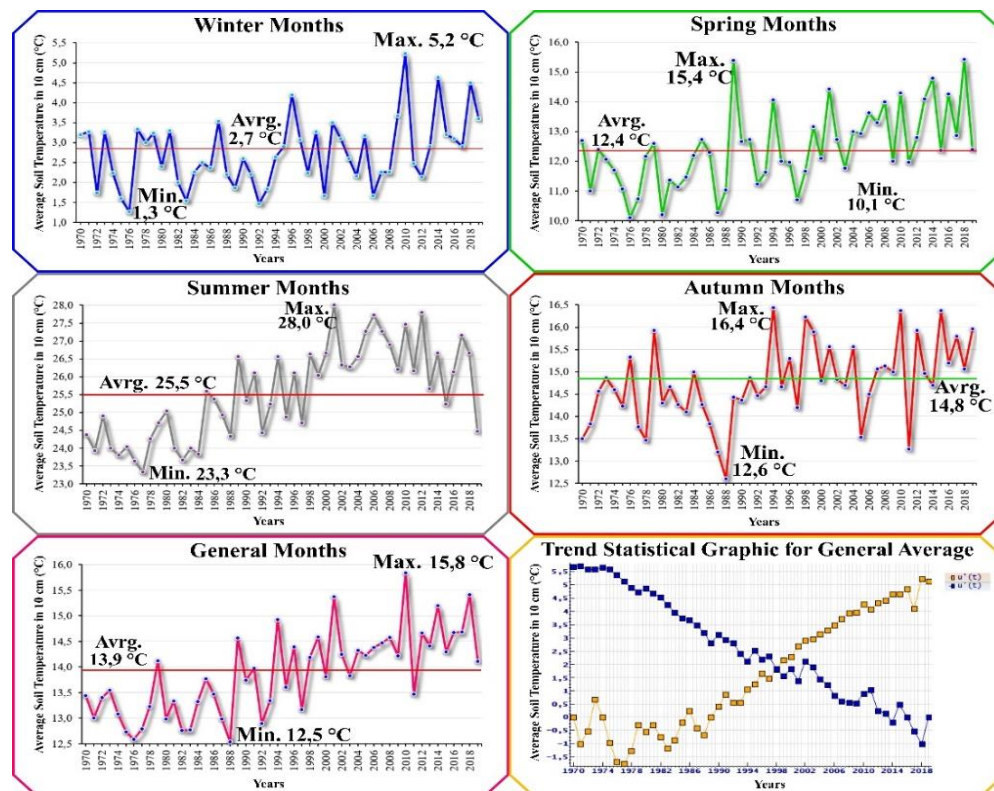












Figure 5: Changes in Average Soil Temperature at 10 cm Soil Depth

For many years, the average soil temperature at 10 cm depth was 10,5 ° C in 2001, the lowest soil temperature was 7,6 ° C in 1988, and the average soil temperature was 9,1 ° C. In spring, the highest soil temperature was 14,3 ° C in 2018, the lowest soil temperature was 9,5 ° C in 1992 and the

average soil temperature was 11,1 °C. For the summer months, the average soil temperature at the highest 10 cm soil depth was 23,9 °C in 2018, the lowest soil temperature was 18,4 °C in 1992 and the average was 21,1 °C. In the autumn months, the highest 10 cm average soil temperature is 22,5 °C in 2011, the lowest soil temperature is 18,5 °C in 1997 and the average soil temperature is 20,3 °C. According to the general average of all seasons, the highest was 17,7 °C in 2018, the lowest was 13,4 °C in 1992 and the average soil temperature was 15,4 °C. The average soil temperature trend analysis results in Nigde Center for 10 cm soil depth are given in Table 3.4.

Table 4: Trend Analysis Results of Average Soil Temperatures at 10 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman'in Rho Test Statistical
Average Soil Temperature in 10 cm	Spring	Positive Trend 	Positive Trend 
	Winter	Positive Trend 	No Trend 
	Autumn	Positive Trend 	Positive Trend 
	Summer	Positive Trend 	Positive Trend 
	General Average	Positive Trend 	Positive Trend 

According to the results of the trend analysis, an increasing trend was observed in the Mann-Kendall Test in the winter months. According to Sperman's Rho Test, there is no trend in winter. An increasing trend was observed in spring, summer, autumn and general average values.

3.5. Changes in Average Soil Temperatures at 50 cm Soil Depth

The change in the average soil temperature values at 50 cm soil depth is also shown in detail in the graph given in Figure 6.

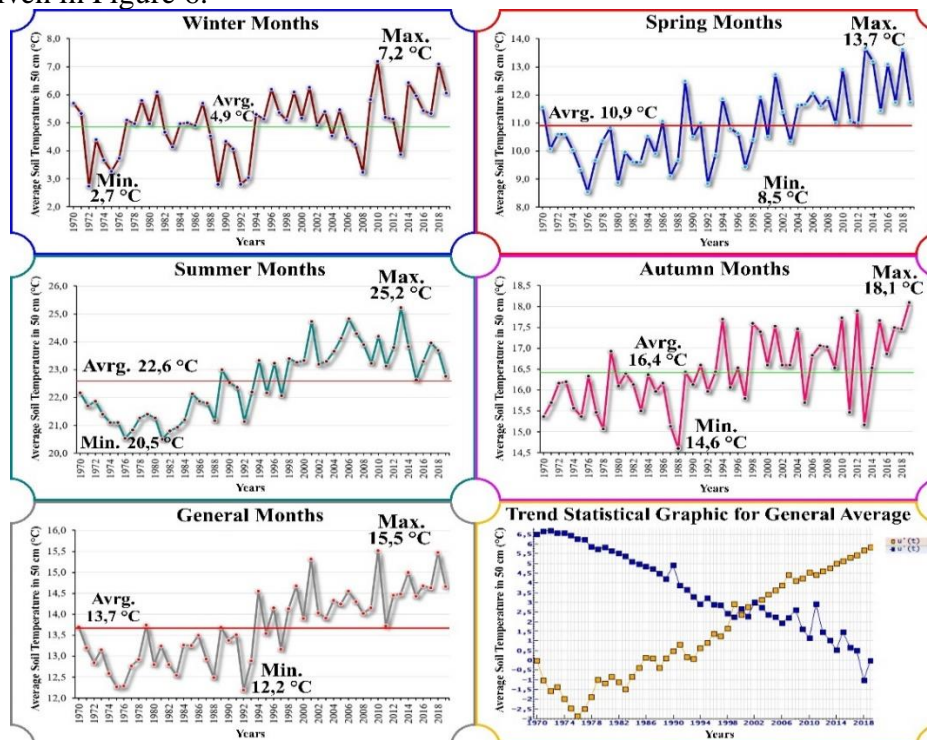












Figure 6: Changes in Average Soil Temperatures at 50 cm Soil Depth

For many years, the average soil temperature values at a depth of 50 cm depth in winter months were 7,2 °C in 2011, the lowest soil temperature was 2,7 °C in 1972 and the average soil temperature was 4,9 °C. In spring, the highest soil temperature was recorded as 13,7 °C in 2013, the lowest soil temperature was 8,5 °C in 1976, and the average soil temperature was recorded as 10,9 °C. The highest soil temperature for the summer months was 25,2 °C in 2013, the lowest soil temperature was 20,5 °C in 1976, and the average soil temperature in the summer was 22,6 °C.

The highest soil temperature at the depth of 50 cm depth for autumn months is 18,1 °C in 2019, the lowest soil temperature is 14,6 °C in 1988 and the average soil temperature is 16,4 °C.

According to the average of all seasons; The highest soil temperature was recorded as 15,5 °C in 2010, the lowest soil temperature as 12,2 °C in 1992 and the average soil temperature as 13,7 °C. Seasonal trend analysis test was performed on average soil temperature values at 50 cm soil depth. The test results are shown in the table given in Table 5.

Table 5: Trend Analysis Results of Average Soil Temperatures at 50 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman'in Rho Test Statistical
Average Soil Temperature in 50 cm	Spring	Positive Trend 	Positive Trend 
	Winter	Positive Trend 	Positive Trend 
	Autumn	Positive Trend 	Positive Trend 
	Summer	Positive Trend 	Positive Trend 
	General Average	Positive Trend 	Positive Trend 

According to trend analysis results; In the Rho Tests of Mann-Kendall and Sperman’s Rho Test, there was an increasing trend in spring, summer, autumn, winter and general average.

3.6. Changes in Average Soil Temperature at 100 cm Soil Depth

Average soil temperature values in 100 cm depth which were analyzed for many years (1970-2019), were evaluated seasonally (spring, autumn, summer and winter months) by trend analysis. The change of the average soil temperature values of 100 cm depth is shown in detail in the graph given in Figure 7.

In winter, the soil temperature values at a soil depth of 100 cm soil depth were highest at 9,9 °C in 2011, the lowest soil temperature was 6,4 °C in 1993 and the average soil temperature was 8,1 °C. The highest soil temperature in spring was 12,6 °C in 2018, the lowest soil temperature was 8,0 °C in 1976 and the average soil temperature in spring was 10,1 °C.

The highest soil temperature in summer months was 21,2 °C in 2007, the lowest soil temperature was 17,2 °C in 1976 and the average soil temperature was 19,3 °C. The highest soil temperature for autumn months is 18,9 °C in 2019, the lowest soil temperature is 15,9 °C in 1988 and the average soil temperature is 17,5 °C.

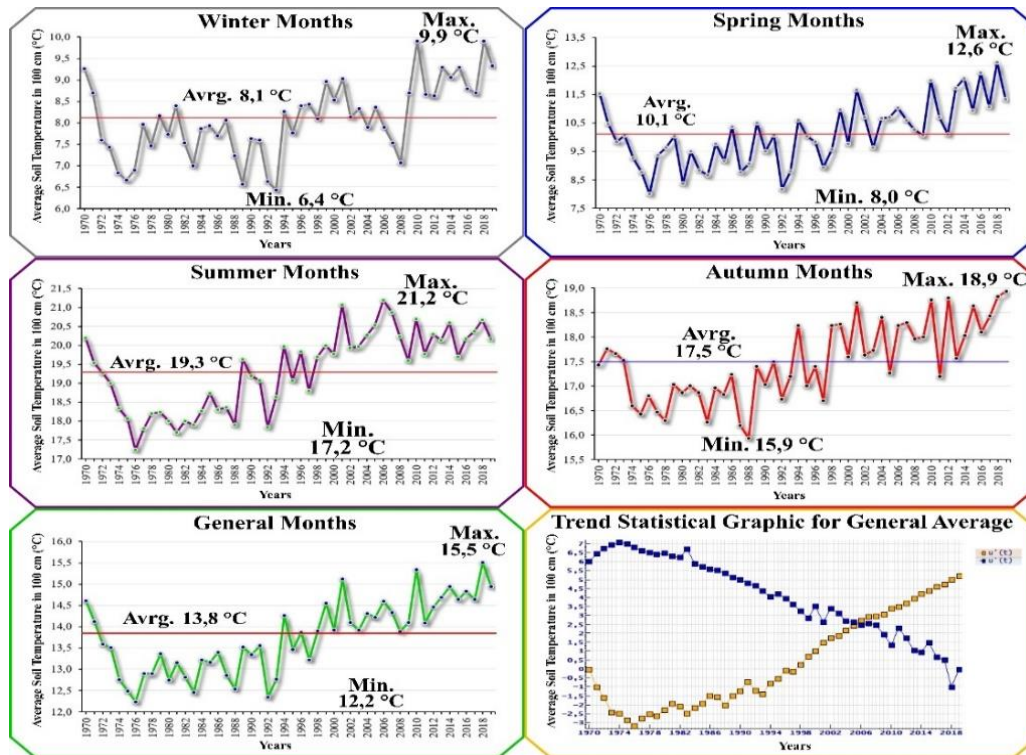


Figure 7: Changes in Average Soil Temperature at 100 cm Soil Depth

Considering the general average of all seasons, the highest soil temperature was recorded as 15,5 °C in 2018, the lowest soil temperature as 12,2 °C in 1976 and the average soil temperature as 13,8 °C. Trend analysis test results for soil temperature values at a depth of 100 cm depth are shown in the table given in Table 6.

Table 6: Trend Analysis Results of Average Soil Temperatures at 100 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test	Spearman'in Rho
		Statistical	Test Statistical
Average Soil Temperature in 100 cm	Spring	Positive Trend	Positive Trend
	Winter	Positive Trend	Positive Trend
	Autumn	Positive Trend	Positive Trend
	Summer	Positive Trend	Positive Trend
	General Average	Positive Trend	Positive Trend

According to Mann-Kendall and Sperman’s Rho Test, there is an increasing trend in spring, summer, autumn, winter and general average.

3.7. Changes in Minimum Soil Temperatures at 10 cm Soil Depth

For long years (1970-2019) minimum soil temperature values of 10 cm soil depth were evaluated seasonally (spring, autumn, summer and winter months) with trend analysis. The change in the minimum soil temperature values of 10 cm is given in the graph given in Figure 8.

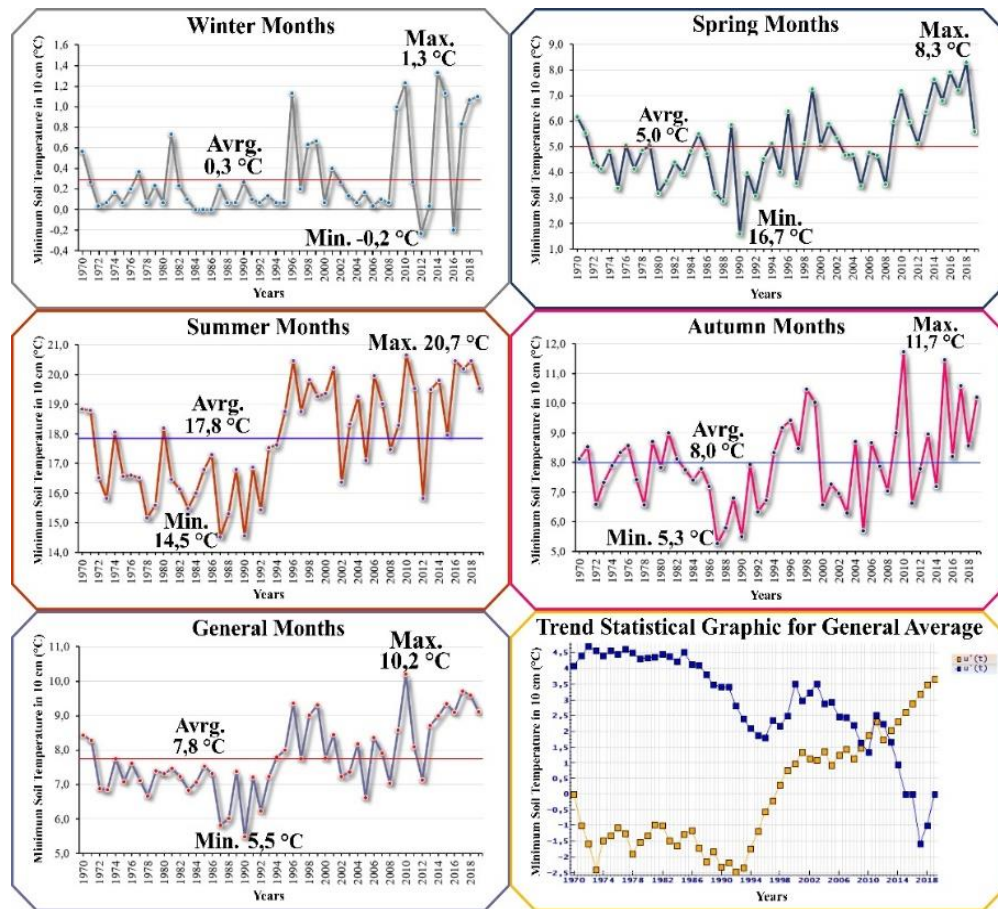


Figure 8: Changes in Minimum Soil Temperature at 10 cm Soil Depth

In the winter months, the minimum soil temperature values at a depth of 10 cm were highest at 5,2 °C in 2011, the lowest soil temperature at 1,3 °C in 1976 and an average soil temperature of 2,7 °C. In spring, the highest minimum soil temperature was recorded as 15,4 °C in 1989, the lowest soil temperature in 1976 was 10,1 °C and the average of minimum soil temperatures at 10 cm depth was 12,4 °C.

The highest soil temperature for summer months was 28,0 °C in 2002, the lowest soil temperature was 23,3 °C in 1976 and the minimum soil temperature average was 25,5 °C. The highest minimum soil temperature for autumn months was 16,4 °C in 1995, the lowest soil temperature was 12,6 °C in 1988 and the average soil temperature was 14,8 °C.

Looking at the general average of all seasons; The minimum soil temperature at the highest 10 cm depth was recorded as 15,8 °C in 2010, the lowest at 12,5 °C in 1988 and the average soil temperature as 13,9 °C.

The trend analysis results for minimum soil temperature values of 10 cm depth for long years in Nigde center are given in Table 7.

Table 7: Trend Analysis Results of Minimum Soil Temperatures at 10 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman's Rho Test Statistical
Minimum Soil Temperature in 10 cm	Spring	Positive Trend	Positive Trend
	Winter	Positive Trend	No Trend
	Autumn	No Trend	No Trend
	Summer	Positive Trend	Positive Trend
	General Average	Positive Trend	Positive Trend

According to the results Tests of Mann-Kendall and Sperman's Rho test, it is seen that there is an increasing trend in spring, summer and general average. There was no significant trend in the autumn months.

3.7. Changes in Minimum Soil Temperatures at 50 cm Soil Depth

The minimum soil temperature values at a depth of 50 cm soil depth were evaluated seasonally (spring, autumn, summer and winter months) by trend analysis for many years (1970-2019). The change of minimum soil temperature values at a depth of 50 cm were given in Figure 9.

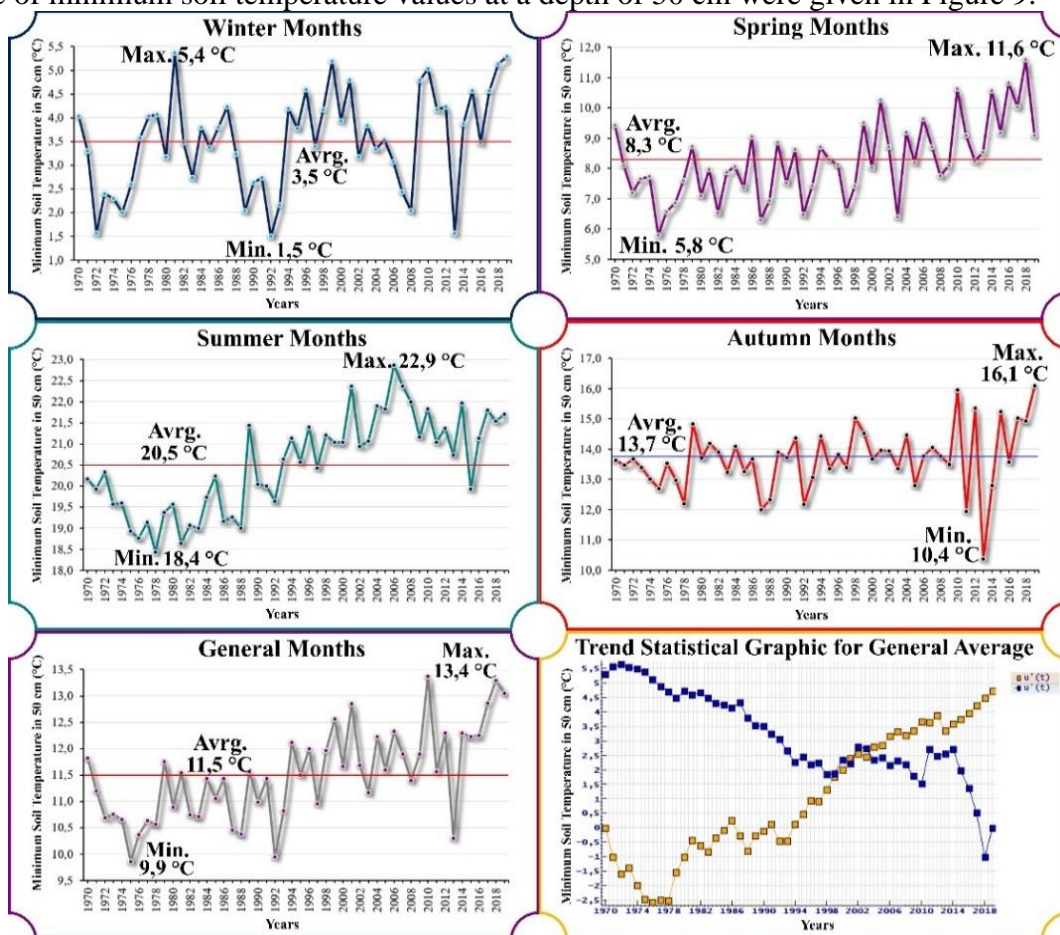












Figure 9: Changes in Minimum Soil Temperatures at 50 cm Soil Depth

The minimum soil temperature values at a depth of 50 cm in winter months were 7,2 °C in 2011, the lowest soil temperature was 2,7 °C in 1972 and the average soil temperature was 4,9 °C. The highest soil temperature in the spring months was 13,7 °C in 2013, the lowest soil temperature was 8,5 °C in 1976 and the average soil temperature was 10,9 °C. The highest soil temperature for summer months was 25,2 °C in 2013, the lowest soil temperature was 20,5 °C in 1976 and the minimum soil temperature average was 22,6 °C.

The highest minimum soil temperature for autumn months is 18,1 °C in 2019, the lowest soil temperature is 14,6 °C in 1988 and the average soil temperature is 16,4 °C. According to the general average of all seasons, the highest soil temperature was recorded as 15,5 °C in 2010, the lowest soil temperature as 12,2 °C in 1992 and the average soil temperature as 13,7 °C.

Trend analysis test results for minimum soil temperature values at 50 cm depth for many years are shown in the table given in Table 8.

Table 8: Trend Analysis Results of Minimum Soil Temperatures at 50 cm Soil depth

<i>Data and Period:</i> 1970 - 2019	<i>Periods</i>	<i>Mann-Kendall</i> <i>Test Statistical</i>	<i>Spearman'in Rho</i> <i>Test Statistical</i>
<i>Minimum Soil Temperature in 50 cm</i>	Spring	Positive Trend 	Positive Trend 
	Winter	Positive Trend 	Positive Trend 
	Autumn	No Trend 	No Trend 
	Summer	Positive Trend 	Positive Trend 
	General Average	Positive Trend 	Positive Trend 

According to the results of the trend analysis, it was observed that there was an increasing trend in the spring, summer, winter and general average. It was observed that there was no significant trend in the autumn months.

3.8. Changes in Minimum Soil Temperatures at 100 cm Soil Depth

The minimum soil temperature values of 100 cm soil depth were evaluated seasonally (spring, autumn, summer and winter months) with trend analysis for long years (1970-2019). The change in minimum soil temperature values in 100 cm depth is also shown in detail in the graph given in Figure 10.

For many years, the minimum soil temperature values at a depth of 100 cm soil depth in winter months were 9,9 °C in 2010, the lowest soil temperature was 6,4 °C in 1993 and the average soil temperature was 8,1 °C.

In spring, the minimum soil temperature was 12,6 °C in 2018, the lowest soil temperature was 8,0 °C in 1976 and the minimum soil temperature average value was calculated as 10,1 °C.

The highest minimum soil temperature for summer months was 21,2 °C in 2006, the lowest soil temperature was 17,2 °C in 1976 and the minimum soil temperature average was 19,3 °C.

The highest minimum soil temperature for autumn months in 100 cm soil depth was 18,9 °C in 2019, the lowest soil temperature was 15,9 °C in 1988 and the average soil temperature was 17,5 °C.

According to the general average of all seasons, the highest value among the minimum soil temperature changes at a depth of 100 cm was recorded as 15,5 °C in 2018, the lowest temperature as 12,2 °C in 1976 and the average soil temperature as 13,8 °C.

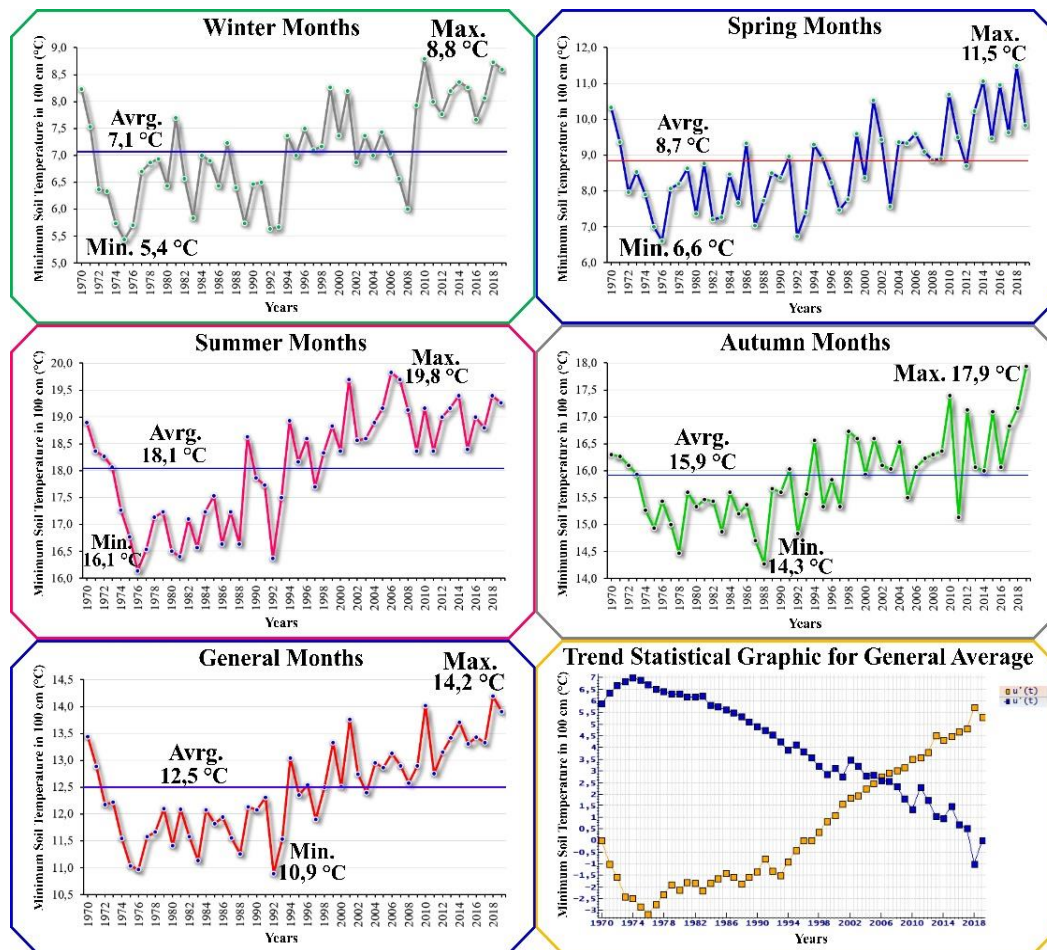


Figure 10: Changes in Minimum Soil Temperature at 100 cm Soil Depth

The seasonal trend analysis results of Nigde Center in 100 cm soil depth, minimum soil temperature values were shown in Table 9.

Table 9: Trend Analysis Results of Minimum Soil Temperatures at 100 cm Soil Depth

Data and Period: 1970 - 2019	Periods	Mann-Kendall Test Statistical	Spearman'in Rho Test Statistical
Minimum Soil Temperature in 100 cm	Spring	Positive Trend	Positive Trend
	Winter	Positive Trend	Positive Trend
	Autumn	Positive Trend	Positive Trend
	Summer	Positive Trend	Positive Trend
	General Average	Positive Trend	Positive Trend

According to the results of the trend analysis conducted at the Nigde Center for minimum soil temperature at a depth of 100 cm depth for many years, it has been determined that there is an

increasingly significant trend in the spring, summer, autumn, winter and general average. According to the data received from the meteorology station in Niğde Center, the minimum, maximum and average values of soil temperatures at a depth of 10, 50, 100 cm were analyzed. Long years (1970-2019) were selected from winter months, January, spring months, April, summer months, July and autumn months, and the average of 50 years was taken and given in Figure 11.

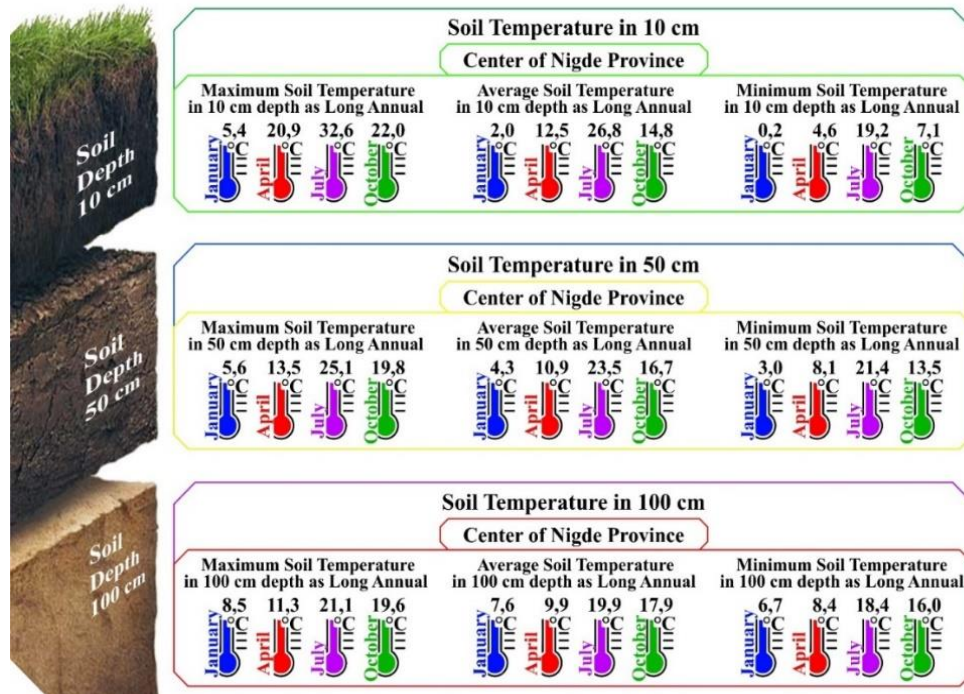


Figure 11: Average Temperature Values in 10 cm, 50 cm, 100 cm Soil Depths in January, April, July and October

Considering the average values of soil temperatures, the highest soil temperature in July is observed in January. The minimum soil temperature was highest in July and the lowest minimum soil temperature was observed in January.

4. Conclusions and Recommendations

This study was carried out to reveal the course of the change of soil temperatures at different soil depths in the Niğde Center for long years (1970-2019). In this context, 50 years and 600 months soil temperature data were analyzed. Soil temperatures at 10 cm, 50 cm and 100 cm were analyzed as minimum, maximum and average temperature values.

The slope method statistical approaches of Mann-Kendall, Sperman's Rho and Sen's slope method were used in the study.

Considering the soil temperature values at a depth of 10 cm depth, the average of the maximum soil temperature values were 6,8 °C for winter months, 21,7 °C for spring months, 32,0 °C for summer months, 21,3 °C for autumn months and their general average was determined as 20,2 °C.

The average of minimum soil temperature values at 10 cm depth was observed 0,3 °C for winter months, an average of 5,0 °C in spring, an average of 17,8 °C in summer, 8,0 °C in autumn and a general average of 7,8 °C.

Average soil temperature values at a depth of 10 cm depth were observed 2,7 °C for winter months, 12,4 °C for spring months, 25,5 °C for summer months, 14,8 °C for autumn months and 13,9 °C for general average.

According to the soil temperature values of 50 cm depth; The average of long annual maximum soil temperature values were designated 6,6 °C for winter months, 13,6 °C for spring months, 24,4 °C for summer months, 19,1 °C for autumn months and 15,9 °C for general average. The average of minimum soil temperature values at 50 cm depth was observed 3,5 °C for winter months, 8,3 °C for spring months, 20,5 °C for summer months, 13,7 °C for autumn months and 11,5 for general average.

Average soil temperatures of 50 cm depth were determined 4,9 °C for winter months, 10,9 °C for spring months, 22,6 °C for summer months, 16,4 °C for autumn months and 13,7 ° for general average.

According to the soil temperature values at a depth of 100 cm; The average annual maximum soil temperature values were determined 9,2 °C for winter months, 11,5 °C for spring months, 20,5 °C for summer months, 19,0 °C for autumn months and 15,1 °C for general average. Average soil temperature values are 8,1 °C for winter, 10,1 °C for spring, 19,3 °C for summer, 17,5 °C for autumn and 13,8 °C for general average. It has been identified. The average of minimum soil temperature values at a depth of 100 cm soil depth was determined 7,1 °C for winter months, 8,7 °C for spring months, 18,1 °C for summer months, 15,9 °C for autumn months and 12,5 °C for general average.

In this study, which was carried out within the scope of evaluating the temperature changes due to the global climate change in Nigde Center for many years, it was observed that there was an increase in soil temperatures at 10 cm, 50 cm and 100 cm soil depths.

The change of the temperature of the soil according to time and distance (soil depth) constitutes the temperature condition of the soil. The change of temperature in the soil surface and its layers is generally in harmonic (sinusoidal or cosynoidal) form. Temperature significantly affects soil formation processes, soil heat balance, physical, chemical, biological properties and plant growth. The change of soil temperature is related to the thermo-physical properties of the soil (temperature delay time and extinction depth, heat capacity, thermal diffusion, thermal conductivity) as well as soil properties [10].

Temperature is an important feature that directs physical and chemical processes, which has a significant effect on biological events occurring in the soil. Although the chemical and biological activities are almost stopped when the soil freezes, physical decomposition continues effectively. Root development of most plants stops at temperatures below 5°C [11]. Temperature is a very important parameter used in different fields such as hydrology, soil science, geotechnology, ecology, meteorology, agriculture and environmental studies [12].

The control of soil physical conditions is needed to ensure that they are at the optimum levels in terms of plant growth and for the purposes of soil conservation [13]. Temperature differences in different parts of the earth indirectly direct soil formation by affecting the rate of chemical events occurring in the soil [14]. The distribution of temperature along the soil surface and profile is a factor that has a significant impact on soil properties and fertility [15]. As the temperature increases, the amount of organic matter in the soil and therefore nitrogen decreases due to the increasing microorganism activity [16]. Although the soil temperature is affected by many properties of the soil, it is known that it warms and cools later than air [17].

By reducing the amount of moisture in the overheated soil, it will cause the plant not to meet the water requirement from the soil as much as it needs, and it will inefficient the soil. Plants that are not suitable for climatic conditions as the temperature decreases, and cold-resistant plants will be affected by root and cause drying. As a result, the growing trend of the soil temperature seasonally affects the plants, crops and living life in the soil negatively.

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