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Thermal Characteristics of Lattakia Governorate during the Period 1990-2020

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Abstract:
Temperature is the essential element for understanding and analyzing climatic characteristics in any region, and in order to understand temperature behavior in Lattakia Governorate, it was studied during the climatic cycle between 1990-2020 through mathematical and statistical evidence and indicators based on statistical programs Excel2019, Spss26 and ArcGis10.5 geographic information systems , where the values of the coefficient of variation (did not exceed 5%) revealed the lack of variation and dispersion of the annual mean of temperature from the average period of the study, and the equation of the general trend showed the trend of this climatic element towards a significant increase by 1.3°C, in addition to recording a significant seasonal temperature rise at 95% confidence level.

Keywords: Temperature, Lattakia Governorate, Mean, The Standard Division, The Coefficient of Variation

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Introduction:

The current average annual increase in air temperature in the Mediterranean Basin is estimated to be around 1.5°C compared to pre-industrial levels that exceed global averages of 1.1°C. [1], where the increase in temperature - as the most important manifestation of climate change - in any region, including Lattakia Governorate, leads to changes that may be fundamental in other elements of the climate; especially precipitation and evaporation so that it has an effect on the periods of water deficit and its recurrence [2], and in order to study the changes in temperature in Lattakia Governorate, the general trend line equation was relied on for the annual, seasonal and monthly averages and the standard deviation of the values from their general rates, in addition to using the coefficient of variation to determine the percentages of dispersal, and the significance of these changes were tested according to the T-test, the program Arc Gis 10.5 and the Spatial Interpolation tool were also used for the cartographic representation of the temporal and spatial variations in temperatures in Lattakia Governorate.

Materials and methods:

Study area:

Lattakia Governorate is located on the eastern coast of the Mediterranean Sea between Iskenderun and Idlib in the north, Hama Governorate in the east and Tartous Governorate in the south, with an area of 2290 km2 and extending 80 km long on the Mediterranean coast [3]. Figure 1

The climate of the study area:

The climate of the study area belongs to the humid Mediterranean climate model according to Ambergé, and is characterized by hot summers (average temperature is 28° C on the coast and 20° C in the mountains) and moderate winters (14° C on the coast and 6° C in the mountains), the values of the marine coefficient rise in the study area, so the thermal variations decrease during the year and the temperature range increases towards the east. Rain falls in winter and during the two transitional seasons, with an average ranging between 650 mm in the plain areas and 1200 mm in the mountainous areas. [3]

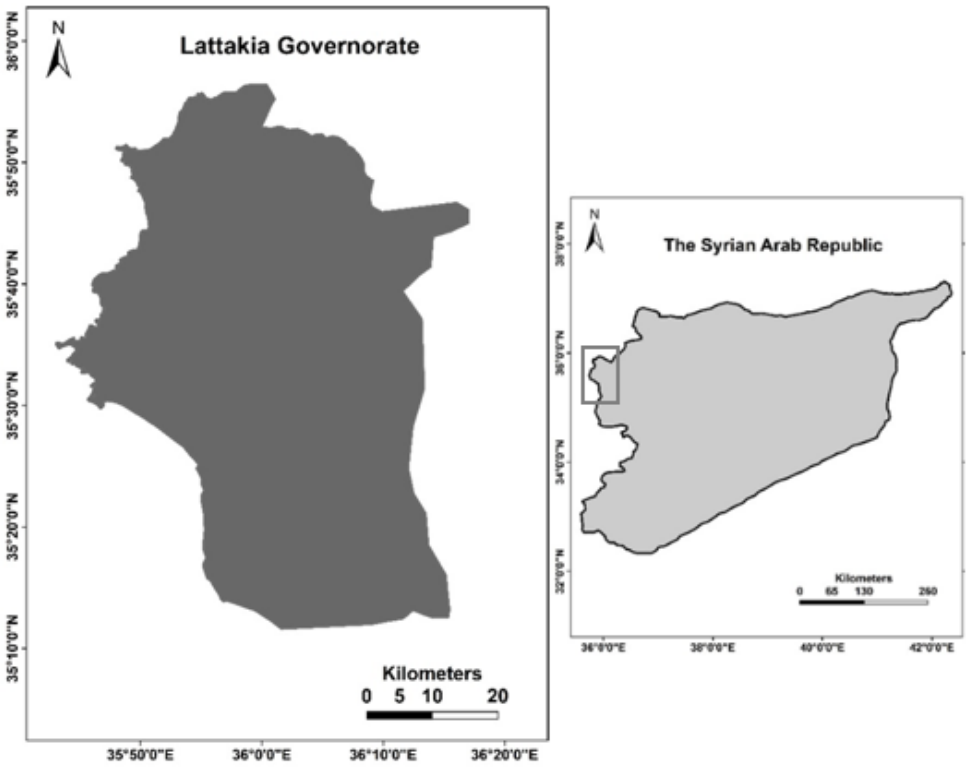

Figure 1 study area location.

Topographical elevation:

The variation in the topographical elevation in the study area led to a fundamental difference in the average temperatures, and the topographical elevation is the first responsible for the spatial variation of this element in Lattakia Governorate, we recognize in the study area two stripes of terrain: the first in the west includes the coast and the coastal plains. The coast of the study area extends on a north-south axis with a length of 80 km, it includes the plains of Lattakia (Zaghrin, Shabtalia, Burj Islam, Damaskro, Lattakia, Jableh), the second in the east includes coastal mountains and hills, which occupy more than 60% of the total area, it extends from north to south between Nahr al-Kabeer al-Shamali in the north and Al-Sin in the south, parallel to the coast. Its average height is 1200-1300 m, and its highest is at the summit of Nabi Yunus near Slanfeh 1510 m. The Al-Bayer and Al-Basit massif takes a northeastern-southwest axis to the north of the coastal mountains between the ravine of the Al-Kabeer Al-Shamali River and the lower basin of the Orontes River [4].

The temperature decreases with the increase in altitude, as the temperature decreases by one degree Celsius at a height of 100 meters above sea level if the air is dry and 0.5 degrees if the air is humid. The value of the Pearson correlation between temperature and topographic elevation in the study area is (-0.97). Altitudes in Lattakia Governorate range from 0-250 m in the west and increase with the eastward direction, reaching 300-350 m in the hilly areas such as Al-Hiffeh and Qirdaha, reaching 600 m in Kensiba and Kastal Al-Ma'af, and exceeding 1000 m in Slenfeh and Jowbat Brghal. Figure 2

Data resources:

Eleven meteorological stations were selected in Lattakia Governorate to study the thermal characteristics, as it was based on the time series data 1990-2020, the selection of stations was based on the location and variation of the topographic elevation in the research area. Table 1 Figure 3

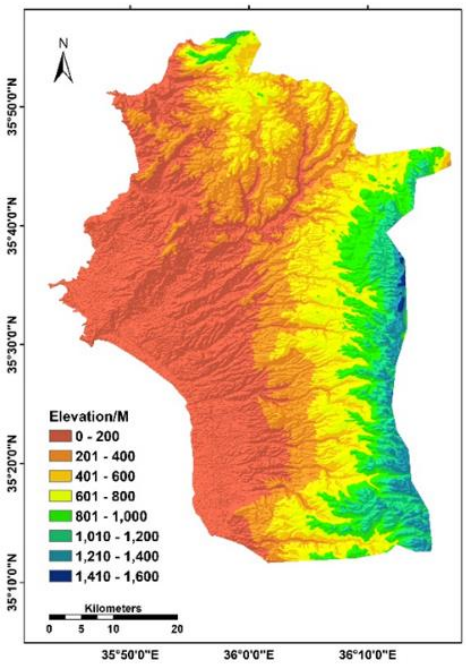

Figure 2: The topographic elevation in the study area according to the DEM model is 30 meters

Table (1) Spatial characteristics of the studied stations.

	station	Longitude	Latitude	Elevation/m	Type
Coastal	AlAzhari	35° 46’ 45"	35° 31’ 25"	7	**Synoptic**
	Al- Sin	35° 58’ 07"	35° 15’ 49"	8	**Climatic**
	AL Basel Airport	35° 56’ 33"	35° 24’ 28"	48	**Synoptic**
hilly	16th Tishreen Dam	36° 0’ 5"	35° 42’ 36"	127	**Climatic**
	Qirdaha	36° 03’ 12"	35° 26’ 56"	300	**Synoptic**
	Hiffeh	36° 02’ 46"	35° 36’ 31"	335	**Climatic**
Mountainous	Kensiba	36° 9’ 50"	35° 44’ 38"	642	**Climatic**
	Kastal Almaaf	35° 56’ 33"	35° 49’ 33"	675	**Climatic**
	Kassab	35° 58’ 53"	35° 54’ 42"	730	**Climatic**
	Jowbat Brghal	36° 10’ 30"	35° 29’ 40"	1000	**Climatic**
	Slenfeh	36° 11’ 23"	35° 34’ 20"	1173	**Climatic**

Source: General Directorate of Meteorology

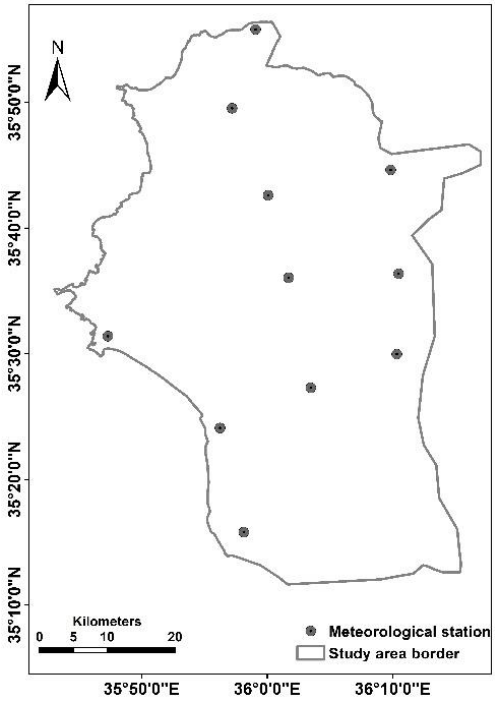

Figure 3: The spatial distribution of the studied climatic stations

Mathematical and statistical indexes

- The coefficient of variation %

$$CV = \frac{Std}{X}$$

std: standard division, x: mean

- Data error rate:

$$\frac{CV}{\sqrt{n}}$$

CV: The coefficient of variation n: the number of years

- Confidence field:

$$X \pm Z\frac{a}{2}.\frac{S_x}{\sqrt{n}}$$

Z a/2: standard error of the probability of accuracy , $\frac{S_x}{\sqrt{n}}$:The standard error of the statistic function

First degree regression equation: $y = ax + b$

- Linear regression equation of the time sequence was drawn to show the amount of change of the regression in the general line, the amount of annual, quarterly and monthly temperatures.
- Moving Averages: The Moving-Averages Method is one of the best statistical methods for studying the nature of oscillations in climatic phenomena, as it reduces the oscillations of the graph around the general trend line and makes the data of the studied series more flowing, which facilitates the process of analyzing these oscillations and classifying them between periods above the general average and others below it, and the longer the moving average period, the less fluctuations in the general trend line.

$$\frac{x1 + x2 + x3 + x4 + x5}{5}$$

- T-Test:

$$\frac{\| x_1 - x_2 \|}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Whereas:
X1 and X2 are the temperature average during the two studied periods.
σ1and σ2 are the standard deviation of temperature during the two studied periods.

n 1 and n2 are the number of the years in each time period

- The Fluctuation factor: max average /min average

Results and discussion:

The changes in the annual average of temperature during the period 1990-2020:

1.1 The annual average of temperature in Lattakia Governorate during the period 1990-2020:

The annual averages of temperatures differ between the studied stations according to two factors: the influence of the sea in modifying temperature and altitude [5]; the annual average temperature rises as we go west towards the plain area of Lattakia Governorate Figure4. In the mountainous region, it ranges between 13.6°C in Slenfeh and 14.4°C in Jowbat Brghal, while it rises in the plain region to 20°C in Al-Azhari and 20.1°C in Al-Sin station. The deviation values differ from the mean, and the standard deviation clearly shows the concept of dispersion, as it is based on the average deviations of the values from the mean **[6]**, the values of deviation from the general average temperature in the study area range between 0.4°C in Slenfeh and 0.5°C in Kastal Al-Ma'af and Jowbat Brghal and 0.6°C in Al-Basel Airport and it rises to 0.8°C in the Qirdaha station. Table 2

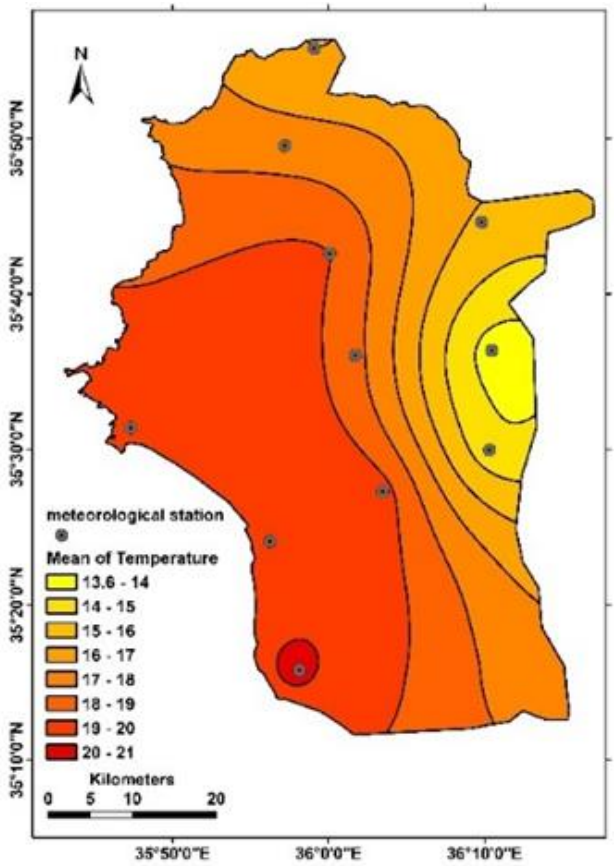

Figure 4 The annual average of temperature during the period 1990-2020

The coefficient of variation ratios indicate that temperatures deviated from their general rates during the period 1990-2020 by small percentages, not reaching 5%, which reflects the lack of dispersion of the values and their concentration around their annual average due to the marine characteristics of Lattakia Governorate, where the Kassab station records a coefficient of variation of 4.4% due to its height above sea level, while the variation values decrease in the plain stations such as Al-Azhari, Al-Basel Airport and Al-Sin (3.4%, 3.1%, 3.5%) because of the effect of the sea in reducing the temperature differences, the coefficient of variation in the entire study area reached 3.4%. The annual temperature range increases in the eastward direction and with the increase in the altitude above sea level, it reaches (15.1°C, 15.2°C, 15.8°C) in the coastal stations, while it rises in Slenfeh and Kassab to (17.2°C, 17.7C°) and the highest annual temperature range is recorded in the station Kensiba (18.4°C) due to its distance from the influence of the sea

Table (2) The annual average of temperature, coefficient of variation and error rate in the data during the period 1990-2020

Station	Elevation	Annual mean	Annual range	STDEV	CV%	Confidence field 95%	Data error rate
16Teshreen Dam	127	19	17.1	0.7	3.7	[19.2-18.8]	**0.7**
Kastal Almaaf	675	17.5	17.6	0.5	2.9	[17.9-17.3]	**0.5**
Kassab	730	16	17.7	0.7	4.4	[16.2-15.8]	**0.8**
Hiffeh	335	18.3	17.4	0.7	3.8	[18.5-18.1]	**0.7**
QIRDAHA	300	19.4	16	0.8	4.1	[19.7-19.1]	**0.7**
Al Sin	8	20.1	15.1	0.7	3.5	[20.3-19.9]	**0.6**
AL BASSL Airport	48	19.4	15.2	0.6	3.1	[19.6-19.2]	**0.6**
AlAzhari	7	20	15.8	0.7	3.4	[20.2-19.8]	**0.6**
Jowbat Brghal	1000	14.4	15.8	0.5	3.5	[14.6-14.2]	**0.6**
Slenfeh	1173	13.6	17.2	0.4	2.9	[13.7-13.5]	**0.5**
Kensiba	642	15.8	18.4	0.6	3.8	[16-15.6]	**0.7**
Study area	-	17.6	17.7	0.6	3.4	[17.8-17.4]	**0.6**

1.2 First degree regression equation and the moving averages:

The general trend line of the annual average of temperature increased in all the studied stations, and this rise varied from one station to another. Al-Azhari station recorded the highest temperature rise during the studied series which is (1.63°C), while Al-Basel Airport station recorded the lowest temperature increase is (1.04°C), and the value of the thermal rise in the entire the study area is (1.31°C) with an average of 0.04°C per year. The Plateaus stations witnessed an increase in the average of temperature during the period 1990-2020, estimated at 1.5°C in Qirdaha and 1.57°C in the 16th Tishreen Dam station, this increase decreased in the mountainous region to 1.06°C in Slenfeh, 1.07°C in Kastal Al-Ma'af, and 1.29°C in Kassab due to the role of vegetation cover in slowing down the air warming. The results of the T-test showed a high statistical significance for this increase in all stations at the level of Indication 0.05.

The values of the fluctuation factor range between 1.1-1.3, which indicates the lack of fluctuation between the maximum and minimum temperature values. The highest values are recorded in the mountainous region and the lowest in the coastal parts of Lattakia Governorate due to the influence of the sea in reducing the temperature differences **Table 3**

According to the five moving averages method, it was found that there are three periods of average temperature above the general average, which are (1996-2000, 2001-2005, 2016-2020) and three periods of its average below the general average temperature which are (1990-1995, 2006-2010, 2011-2015).

Table 3 The general average of temperatures and the amount of increase during the period 1990-2020 in the stations of Lattakia Governorate

Station	Mean Of temperature	The thermal increase during the study period C°	Statistical significance of the increase at the 95% confidence level.	The hottest year	The coldest year	the fluctuation factor
16Tishreen Dam	19	1.57	*	2018	1992	1.2

Kastal Almaaf	17.5	1.07	*	2018	1992	1.2
Kensiba	15.8	1.3	*	2010 – 2018	1992	1.2
Kassab	16	1.29	*	2010	1992	1.3
Slenfeh	13.6	1.06	*	2018	1992	1.2
Hiffeh	18.3	1.32	*	2018	1992	1.3
QIRDAHA	19.4	1.52	*	2010	1992	1.2
Jowbat Brghal	14.4	1.13	*	2018	1992	1.2
Al Sin	20.1	1.43	*	2018	2005	1.1
AL BASSL Airport	19.4	1.04	*	2010	1992	1.2
AlAzhari	20	1.63	*	2018	1992	1.2
Study area	17.6	1.31	*	2018	1992	1.2

** Increase is significant at the 95% level*

The changes in the seasonal average of temperature during the period 1990-2020:

2.1 The seasonal average of temperature in Lattakia Governorate during the period 1990-2020:

The highest values of the coefficient of variation are recorded in the winter, as the great dispersion in temperatures during this season is due to the continuous fluctuations and instability of weather conditions **[7]**, while the lowest values of the coefficient of variation are recorded during the summer because the summer in Latakia is a stable and calm season, and because what the spring season witnesses in terms of movements and disturbances in the air masses, the temperature variation during the spring was more severe than the temperature variation recorded in the autumn season.

The average winter temperature ranges between (5.3°C in Slenfeh, 12°C in Qirdaha, and 13.3°C in Al-Sin), as shown in **Figure 5,** and the deviation from the mean ranges from 0.5°C to 1.1°C, and the coefficient of variation ratios are high in this season, which reflects the dispersion in temperatures and their distance from their average seasonality compared to the rest of the year, where the winter of the Kassab (mountainous station) records the highest coefficient of variation (12.1%), while it decreases in the Al-Sin (coastal station) to (6.1%) due to the effect of the sea in reducing thermal variations.

Al-Sin station records the highest average temperature during the spring season (18.5°C) with a standard deviation of (0.9°C), and Kastal Al-Ma'af station records the highest average temperature (15.6°C) with a deviation of (1.1°C), and the thermal variance is generally less in the spring than in the winter and higher than the summer and fall variance **Figure 6**.

The average of temperature rises in the summer and reaches 26.4°C in Al-Azhari, and 26.3°C in Al-Sin Station **Figure 7,** the mountainous regions (Jowbat Brghal, Slenfeh and Kastal Al-Ma'af) record the lowest deviation from the average summer temperature of 0.6°C.

The average of temperature in the fall season is (17.5°C) in the mountainous region of Lattakia Governorate, and it rises in the hilly parts to (21.3°C) and in the coastal area to (22.1°C) as shown by **Figure 8**, and the deviation from the average ranges between 0.6°C and 1°C, the coefficient of variation during the fall season does not exceed 4.6%.

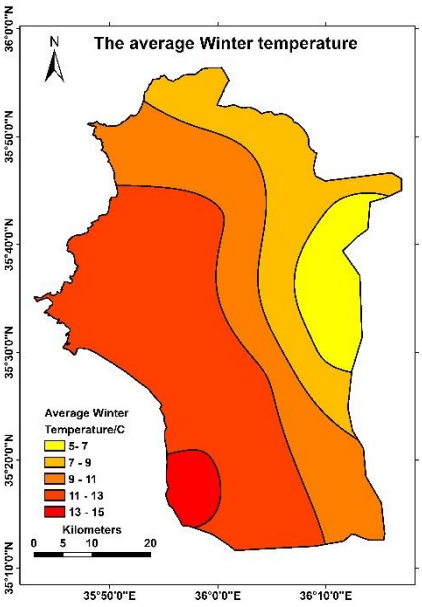

Figure 5 The average winter temperature

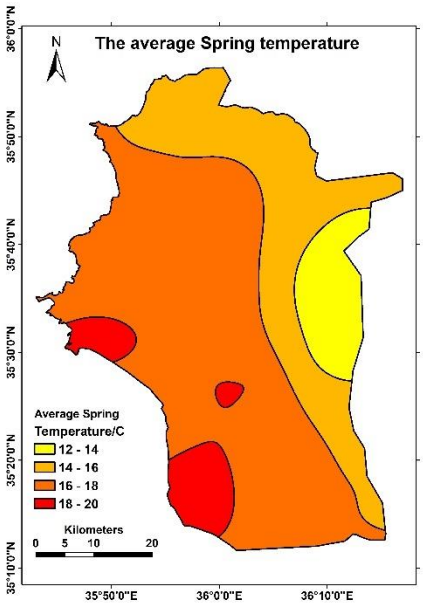

Figure 6 The average spring temperature

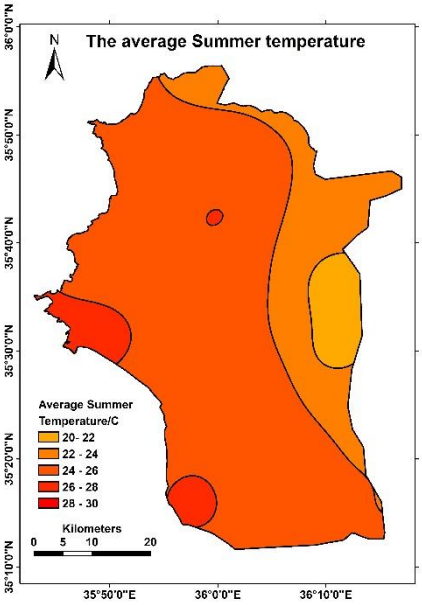

Figure 7 The average winter temperature

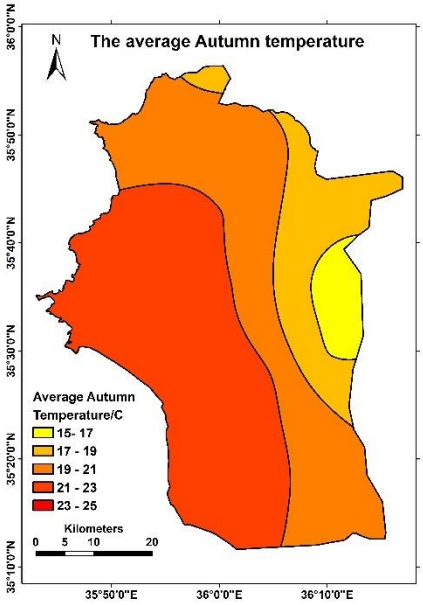

Figure 8 The average spring temperature

2.2. The general trend of seasonal temperatures during the period 1990-2020:

Seasonal temperatures tended to increase in all stations during the period 1990-2020 and during the four seasons, and this increase varied between summer and winter, as the studied stations recorded a temperature rise in summer more than winter and in spring more than autumn.

The increase recorded during the winter season in the studied stations varies between (0.3°_1.5°), and in the summer between (1.5° and 2.4°) during the temporal series 1990-2020, and the increase recorded in temperatures during the spring ranges between (1.4° _2.1°) to decrease during the fall to (0.2°_1.1°) **Table 4** The seasonal temperatures increased significantly in the Kassab and Kensiba stations during the period 1990-2020, although the two stations are relatively far from the influence of urbanization, which indicates that the change was in the general synoptic climatic conditions that prevailed in the eastern basin of the Mediterranean and not as a result of local factors related to the local climate **[8].**

It should be noted that the temperature rates increased during the spring at a higher rate than in the summer at Kastal Al-Ma'af, Kassab and Al-Hiffeh stations, and the T-test showed significant seasonal temperature changes in all stations at a significance level of 0.05 except for the changes recorded in the fall of Al-Basel Airport Station were insignificant.

Table 4 The seasonal increase in temperature according to the equation of the general trend and the significance of the change in some stations during the period 1990-2020

Station	increase during winter	Statistical significance of the increase at the 95% confidence level.	increase during autumn	Statistical significance of the increase at the 95% confidence level.	increase during summer	Statistical significance of the increase at the 95% confidence level.	increase during spring	Statistical significance of the increase at the 95% confidence level.
16th Tishreen Dam	1.1	*	1.1	*	2.1	*	1.8	*
Kastal Almaaf	0.3	*	0.6	*	1.5	*	1.8	*
Kassab	0.9	*	1	*	1.8	*	1.9	*
Kensiba	0.7	*	1	*	1.9	*	1.7	*
Hiffeh	0.8	*	0.6	*	1.9	*	2	*
Qirdaha	1.5	*	0.7	*	2.1	*	1.9	*
Slenfeh	0.5	*	0.7	*	1.6	*	1.4	*
Jowbat Brghal	0.6	*	0.8	*	1.7	*	1.5	*
Al Sin	0.5	*	1	*	2.4	*	1.9	*
AL BASSL Airport	0.6	*	0.2	-	1.8	*	1.5	*
AlAzhari	1.2	*	1.1	*	2.1	*	2.1	*

* Increase is significant at the 95% level - increase is insignificant at the 95% level

The changes in the monthly average of temperature during the period 1990-2020:

3.1 The monthly average of temperature in Lattakia Governorate during the period 1990-2020

Solar radiation declines to its lowest level in December due to the sun's perpendicularity over Capricorn, so the length of the day is shortened and temperatures drop, and the lowest temperatures are recorded in January, after which the values of solar radiation gradually rise from February until May, and the month of June records the highest radiation values However, the highest average temperatures are recorded in August and this is due to the marine characteristics of the study area, which led to the delay of maximum thermal heating until the month of August, after which the solar radiation decreases until November, when the ground losses outweigh the solar radiation, causing the temperature to decline**.[9]**

The temperature deviation from its monthly averages is severe during the month of November and December in the study area in general, while the temperature gains its highest deviation during the months of March and October, and Qirdaha records its greatest dispersal during the month of February.

- The average January temperature in the mountainous areas was (4.4°C in Slenfeh, 6°C in Kensiba and Jowbat Brghal, 6.5°C in Kassab and 8.2°C in Kastal Al-Ma'af) and in the hilly areas it was (9.2°C in Al-Hiffeh, 10.3°C

in the 16th Dam station, 11.1°C in Qirdaha) **(figure 11)** and the standard deviation values during this month ranged between (0.6°C in Slenfeh and 1.6°C in Qirdaha) and the temperatures recorded a coefficient variation between (9.1% in Al-Sin and 15.1% in Kasab).

- In February, the average temperature ranged between (5°C in Slenfeh and 13.6°C in Al-Sin) **(figure 12)** and the plateau stations recorded the highest deviation from its mean (1.8°C in Qirdaha, 1.5°C in Al-Hiffeh), and the coefficient of variation ratios in the mountainous region ranged between (15.2% _10.4%) and in the plateau region between (15% _11%) and decreases in the plain area to (8.9%_10.8%).

- The average temperature in March fluctuated in the mountainous areas between (8.4°C and 12.2°C) and in the hilly areas between (13.2°C and 14.4°C) and was recorded in the coastal stations (14.8°C in Al-Basel Airport Station, 15.2°C in Al-Azhari and 15 7°C in Al-Sin) **(figure 13)** and the values of deviation from the mean ranged between (0.8°C _1.7°C), and the coefficient of variation ratios decreased during this month from the previous two months, which indicates the beginning of a decrease in temperature dispersion and the values approaching its average.

- The average temperature rises significantly during the month of April and ranges between (11.7°C in Slenfeh and 18.3°C in Al-Sin station) **(figure 14)** and the deviation values from the general average for this month do not exceed 1.2°C, and the dispersion rates according to the coefficient of variation drop to less than 8%, which It indicates that the values are close to their mean, except the Kasab mountainous station, whose variance coefficient is 8.1%.

- Temperatures moderate during the month of May in Lattakia Governorate, with the lowest average recorded in Slenfeh Station is 16.1°C, while it rises in Al-Sin Station to 21.6°C **(figure 15)**, and the highest dispersion of the average May temperature appears in Slenfeh and Kastal Al-Ma'af Station (7.6% - 7%), while it decreases in the stations of Al-Azhari and Jowbat Brghal to (5.1%). The decrease in the coefficient of variation in this month reflects the start of atmospheric stability due to the withdrawal of the cold northern masses in favor of the hot dry southern masses in the study area. **[10]**

- The average temperature in Lattakia governorate rises with the beginning of the summer, and the month of June records an average of (24.5°C in Al-Azhari station and 24.6°C in Al-Sin, and decreases to 19.7°C in Slenfeh) **(figure 16)**, and the temperatures are stable around its average and the standard deviation values decrease to one degree Celsius and below, except for Al-Sin station 1.2°C, and the coefficient of variation is less than 5% in all stations studied.

- The average temperature in July does not fall below 21°C and rises in Al-Azhari station to 27°C **(figure 17)**, the values of deviation from the average range between (0.6°C in Slenfeh and Jowbat Brghal to 1.9°C in Qirdaha), and the coefficient of variation ratios drop to less than 3% at the stations of Kastal Al-Ma'af, 16th Tishreen Dam, Al-Basel Airport, Al-Azhari, Slenfeh and Jowbat Brghal.

- August is the hottest month in Lattakia governorate, and Al-Azhari station records the highest average temperature for this month (27.8°C), followed by Al-Sin station (27.7°C) and 16th Tishreen dam station (27.4°C) **(figure 18)**, and the standard deviation values range between 1.1°C in Kassab and 0.7 °C In Jowbat Brghal **Figure 9**, Slenfeh and Kastal Al Ma'af, the ratios of the coefficient of variation express the calm atmospheric conditions during this month.

- The average temperature of the month of September in Al-Azhari station is (26.2°C), and it decreases to (20.4°C) in Slenfeh **(figure 19)**, and the standard deviation does not exceed 1.2°C from the average in all the studied stations, and the coefficient of variation ratios (which do not exceed 4% except for the Kassab (5%)) indicates the continuation of the state of atmospheric stability and the concentration of temperatures around its average.

- The monthly averages of temperatures start to decrease during the month of October with the arrival of depressions from the Mediterranean Sea. Its average decreases with the direction eastward towards the mountainous region (23°C in the coast and 17.3°C in the mountainous region) **(figure 20)** and this is accompanied by an increase in deviation (between 0.8°C_1.7°C) and the variance ratios rise to 7.4% in Al-Basel station and 7.5 % in Kassab.

- Temperatures drop significantly in November and record in the plain areas (17.6°C) and in the hilly areas (15.5°C in Hiffeh, 16°C in the 16th Tishreen Dam station and 17.3°C in Qirdaha) and the average drops in the mountainous area to (10.8°C) in Slenfeh **(figure 21)**. The values of deviation from the average rise in Hiffeh to 1.8°C and to 1.7°C in Qirdaha **Figure 10**. The percentage of thermal variance rises in this month due to the control of fluctuating winds resulting from the collision of hot and cold air masses, and the variance is most severe in Hiffeh (11.7%).

- Temperatures in December range between 6.5°C and 7.1°C in the mountainous region and between (13.7°C - 13.8°C) in the coastal part of the study area**(figure 22)**, and the coefficient of variation ratios rise to 15% in Kastal Al-Ma'af, 15.3% in Kasab and 16.4 % in Al-Hiffeh, announcing the beginning of the winter season.

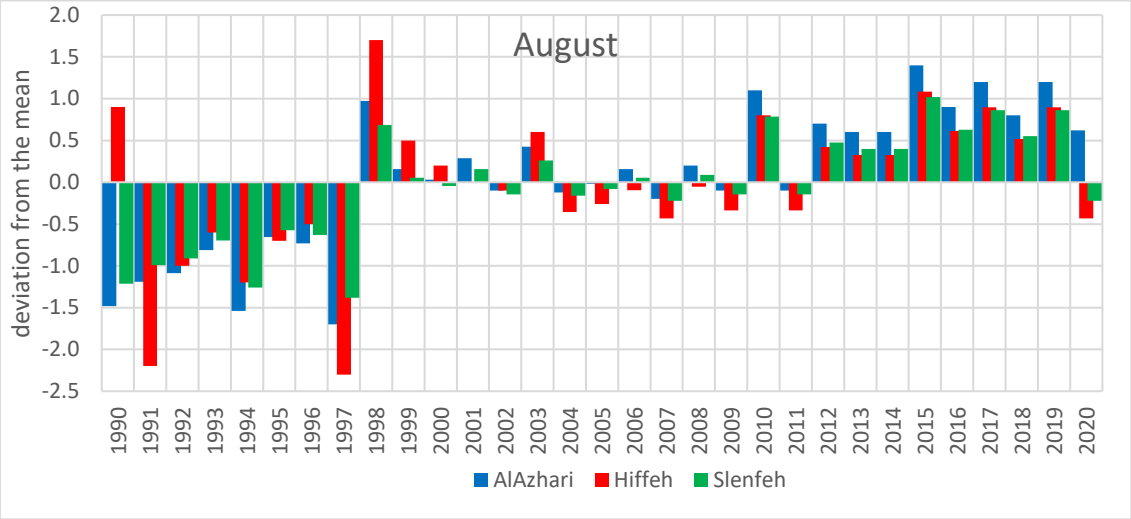

Figure 9 Deviation from the general average for the month of August during the period 1990-2020 in three stations

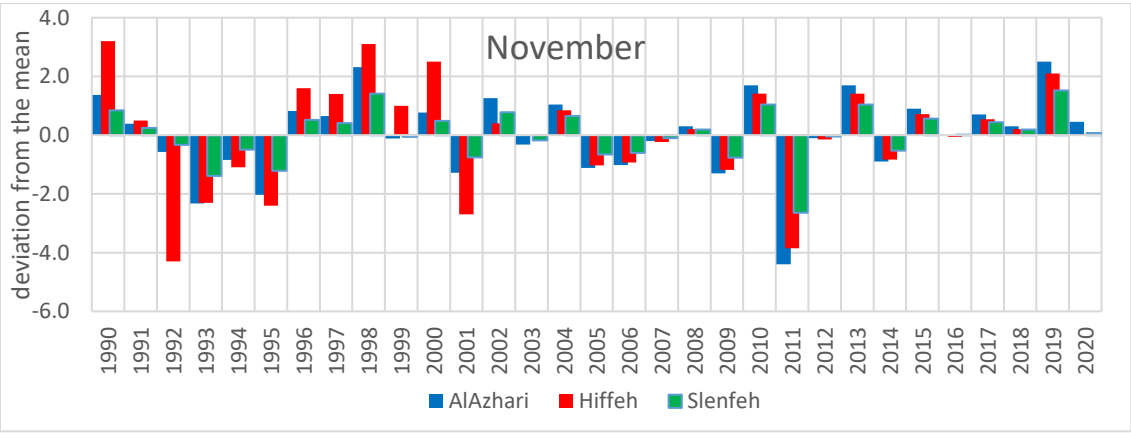

Figure 10 Deviation from the general average for the month of November during the period 1990-2020 in three stations

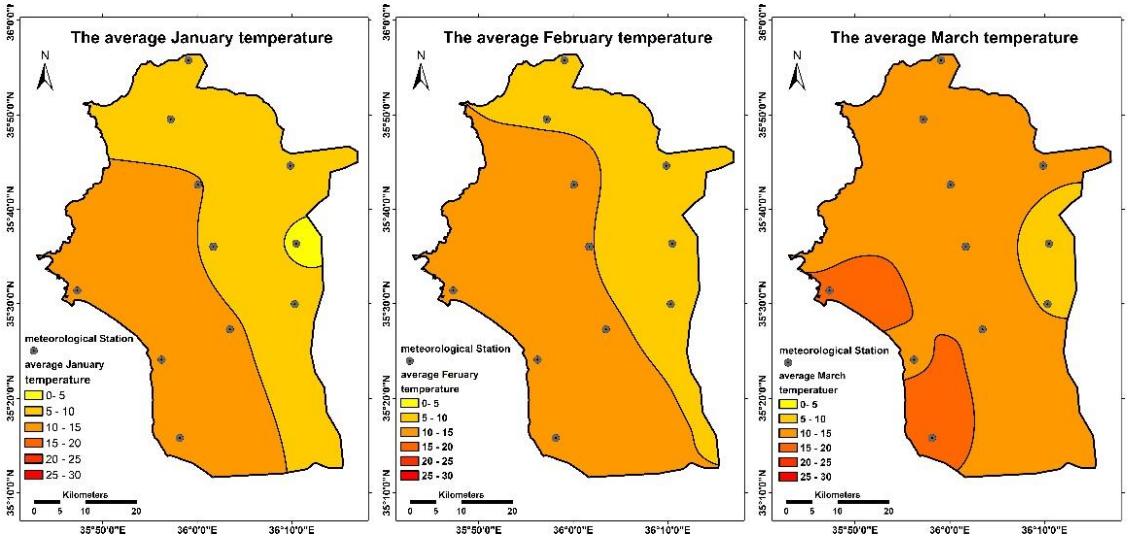

Figure 11 The average January temperature / **Figure 12** The average February temperature/ **Figure 13** The average March temperature

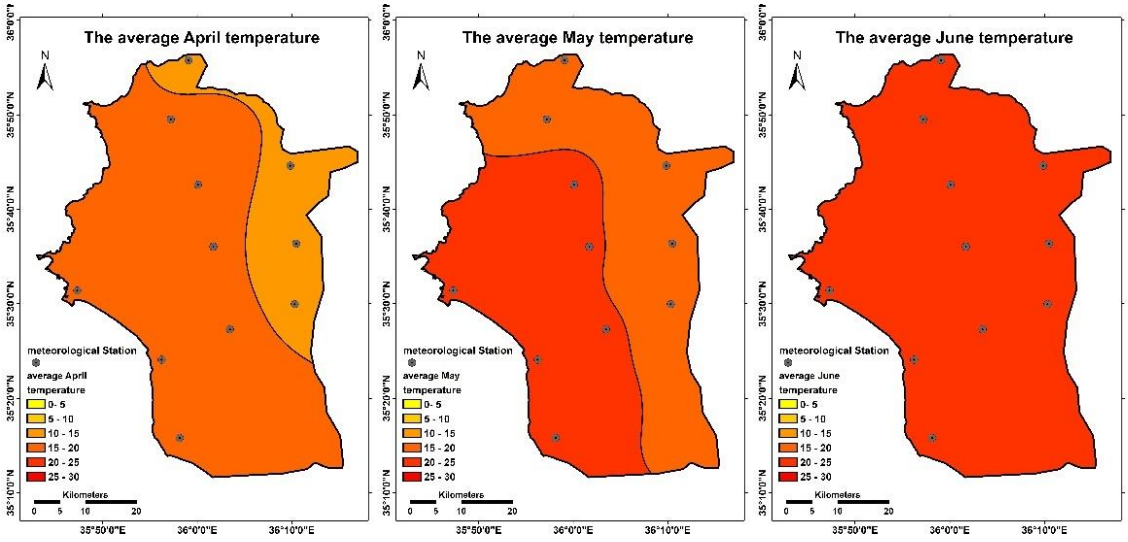

Figure 14 The average April temperature / **Figure 15** The average May temperature/ **Figure 16** The average June temperature

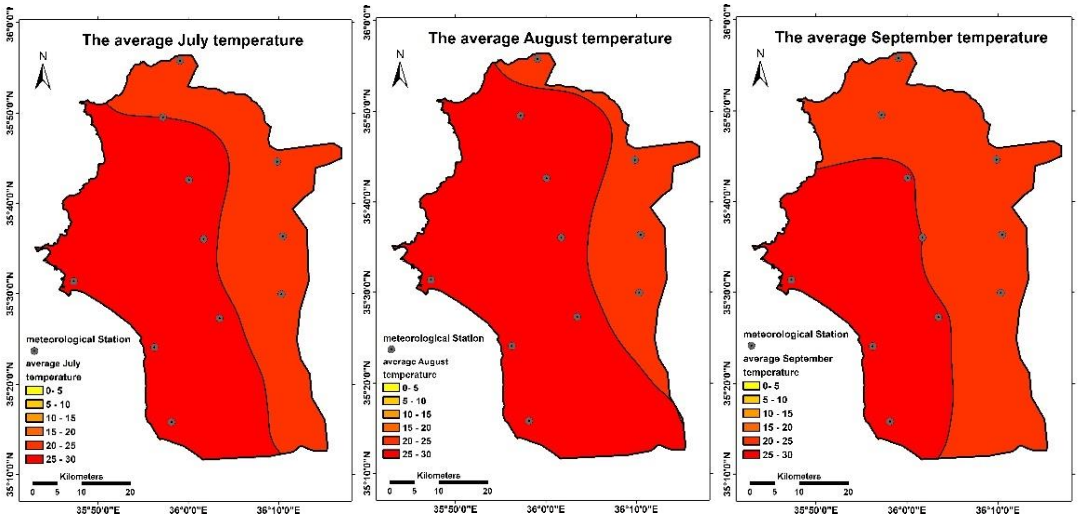

Figure 17 The average July temperature / **Figure 18** The average August temperature/ **Figure 19** The average September temperature

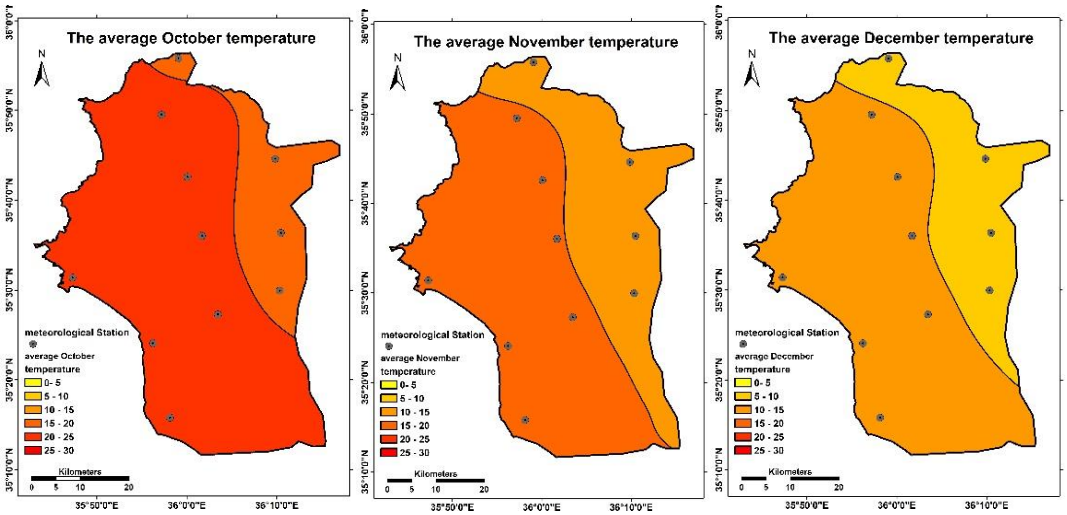

Figure 20 The average October temperature / **Figure 21** The average November temperature/ **Figure 22** The average December temperature

3.2 The general trend of monthly temperatures during the period 1990-2020:

With the trend of the annual and seasonal averages of temperatures to rise in all the studied stations in Lattakia Governorate, some of the monthly averages recorded in some stations a decline (whether significant or not) in their trend line. Table (5) shows the amount of change that occurred in the monthly averages of temperatures during the series 1990-2020 according to the equation of the general trend line of the first degree.

Table (5) shows that the changes that occurred in the average temperature for the month of January during the period 1990-2020 do not bear any statistical significance in the stations (Kassab, Al-Basel Airport, Jowbat Brghal), while the increase in the average temperature recorded during the months of February until September, in all stations of Lattakia Governorate, they were statistically significant at the significance level of 0.05, and in the month of October, the thermal changes were recorded in the stations of Al-Basel Airport, Slenfeh and Al-Azhari, statistically significant at the significance level of 0.05, while these changes were not statistically significant in the rest of the parts of Lattakia Governorate. In general, the changes that occurred in the average temperature of the months of November and December are not important in the stations of Qirdaha, Al-Basel Airport, and Al-Hiffeh, and important in the rest of the stations.

Table 5 The monthly changes in temperature according to the equation of the general trend and the significance of the change in some stations during the period 1990-2020

Changes in the monthly temperature/C	16 th Teshreen Dam	Kastal Almaaf	Kassab	Hiffeh	QIRDAHA	Al Sin	AL BASSL Airport	AlAzhari	Slenfeh	Jowbat Brghal	Kensiba
January	0.4	0.03-	0.1-	0.2	1.3	0.4-	0.1	0.5	0.2	0.2	0.3
Statistical significance of the change	-	-	-	-	*	*	-	*	*	-	-
February	2.2	1.3	1.7	1.9	3	1.5	1.9	2.4	1	1.2	1.5
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
March	2.4	1.8	2.2	2.3	2.6	2.1	2	2.6	1.4	1.7	1.9
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
April	1.2	1	1.5	1.4	1.1	1.1	0.4	1.2	0.8	0.9	1
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
May	2.4	2.6	1.9	2.4	1.9	2.6	2.1	2.4	1.9	1.9	2.1
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
June	2	1.6	1.1	2.2	1.5	2.1	0.5	2	1.6	1.6	1.8
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
July	2	1.5	2.3	2	2.8	2.5	1.9	2	1.5	1.6	1.8
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
August	2.3	1.5	1.9	1.4	1.9	2.5	1.9	2.4	1.7	1.8	2
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
September	2.2	1.5	1.4	1.9	1.8	2.5	1.5	2.3	1.7	1.8	1.9
Statistical significance of the change	*	*	*	*	*	*	*	*	*	*	*
October	0.4	0.2	0.2-	0.4-	0.3-	0.3	0.8-	0.5	0.3	0.3	0.4
Statistical significance of the change	-	-	-	-	-	-	*	*	*	-	*
November	0.8	0.2	0.7	0.4	0.6	0.2	0.02-	0.7	0.4	0.4	0.5
Statistical significance of the change	*	-	*	-	-	-	-	*	*	*	*
December	0.6	0.4-	1.1	0.2	0.1	0.3	0.1-	0.7	0.3	0.3	0.4
Statistical significance of the change	*	-	*	-	-	-	-	*	*	*	*

* Thermal change is significant at the 95% level - thermal change is insignificant at the 95% level

Conclusions:

The integration of mathematical, cartographic and statistical work contributed to give a clear view of the spatial and temporal differences in the average temperatures in Lattakia Governorate, and the t-test helped to clarify the extent of the statistical significance of the observed changes in temperature trend during the period 1990-2020, with the trend of temperatures towards a substantial increase in an important vital area such as Lattakia Governorate, work must be done to implement policies to mitigate emissions first and policies to adapt to thermal rise secondly.

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