

# **Cartographic Representation Of The Displacement Of The Great Thermal Regions In Thi-Qar Governorate**

**By**

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## **Abstract**

The study aims to analyze the seasonal averages of maximum temperatures during the winter, spring, summer and autumn seasons, and to determine their spatial variation using modern geographic techniques, as well as to establish a digital geographic database for average maximum temperatures in Thi Qar Governorate located in southern Iraq between two latitudes (33° 33' 30" °) and (37° 00' 32" N, arc longitudes (12° 38' 45" and (38° 10' 47" E. The study relied on climatic cycle data (33) years divided into three periods, and in processing and analyzing it adopted the inductive method and the technical method (GIS) in analyzing climate data. Al-Khartiyya has five thermal regions that have undergone shifting, as thermal regions recede and others increase in the study area. In general, it became clear that temperatures increase (shift) in every season of the year in the direction from the south of the study area to its north.

**Keywords:** displacement, cartographic modeling, temperature, means of cartographic representation, area gradient.

## **Introduction**

Temperature is one of the most important climatic elements, because of its direct influence on the values of atmospheric pressure and its relationship to the movement of winds, rain and evaporation rate (Al-Shalash, 1988, 37). High temperatures in summer, with mild winters, with a large daily and annual temperature range, and a lack of precipitation, which gives the climate in the region the characteristic of drought. Al-Naqshbandi and Al-Suwaidi, 1999, 22).

### ***The Study Problem:***

- 1- Is there a shift in the regions of maximum temperature in the study area, as well as an increase in temperature rates in the study area from south to north?
- 2- Do geographic information systems contribute to studying and analyzing the climatic characteristics of a particular region?

***Study hypothesis:***

- 1- The presence of significant extremes and a clear shift in the normal temperatures in the study area.
- 2- Geographic information systems contribute to deducing indicators that contribute to making appropriate decisions.

## **Purpose Of The Study**

The study aims to analyze the spatial averages of the maximum temperatures during the winter, spring, summer and autumn seasons.

***The Importance Of Studying:***

The importance of the study is summarized in highlighting a clear picture of the average maximum temperatures in the study area, Dhi Qar Governorate, due to its effects on various aspects of life, as well as its impact on other climate elements.

## **Study Methodology**

The study followed the inductive approach that proceeds from the particles to the colleges, and used geographical information systems (GIS) in the study of climate data for a period of time (33) years, relying on six climatic stations (Nasiriyah station as the main station and the stations of the neighborhood, Maysan, Basra, Samawah, and Diwaniyah as control stations .

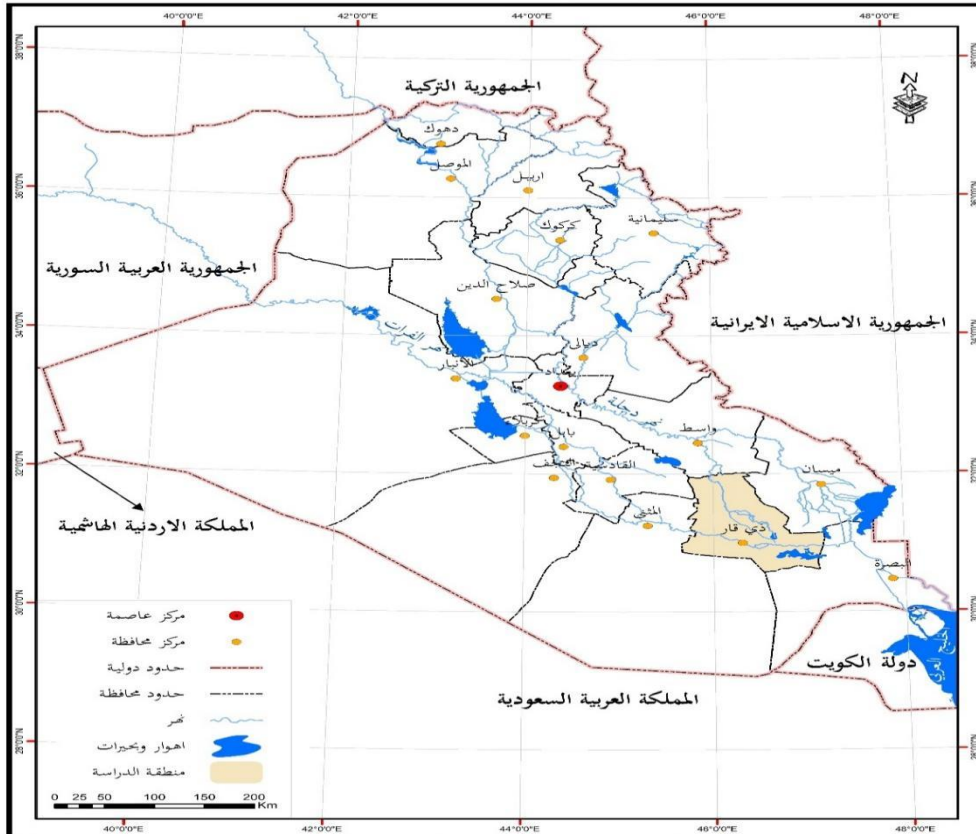
***Study Justifications***

- 1- The study area suffers from the problem of high temperatures, which are often extreme in the seasons of the year.
- 2- The scarcity of geographical studies dealing with the displacement of thermal regions in the study area to know its causes and effects.

***The Boundaries Of The Study Area: Which Included:***

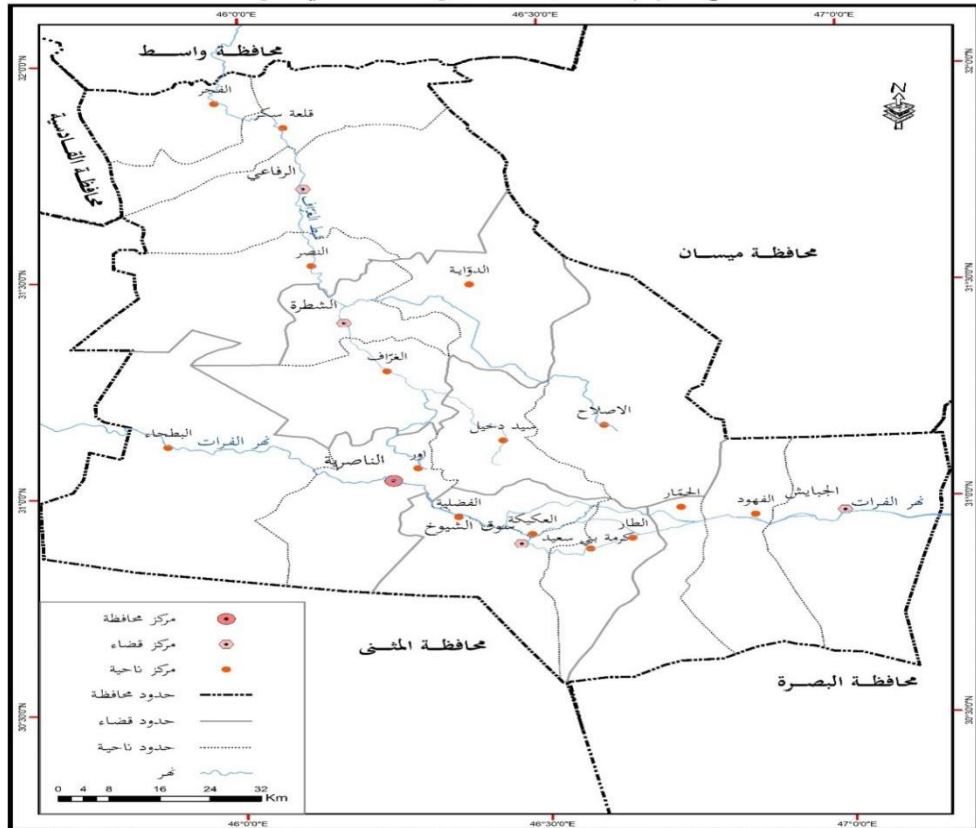
It appears from maps (1, 2) that Dhi Qar governorate lies between latitudes (33° 33' 30") and (37° 00' 32") to the north, and longitudes (12° 38' 45") and (38° 10' 47") to the east, it is bordered by Wasit Governorate to the north, Maysan Governorate to the east and northeast, Basra Governorate to the south and southeast, Muthanna Governorate to the west and southwest, and Al-Qadisiyah Governorate to the northwest. (3.1%) of the total area of Iraq, which amounts to (437,385 km<sup>2</sup>), and it is divided into twenty administrative units (district - sub-district).

خريطة (١) موقع محافظة ذي قار من العراق



المصدر: وزارة الموارد المائية، الهيئة العامة للمساحة، قسم اتاح الخرائط، شب فابل العراق، عام ٢٠١٩

خريطة (٢) التقسيمات الادارية لمحافظة ذي قار



المصدر: وزارة الموارد المائية، الهيئة العامة للمساحة، قسم اتاح الخرائط، شب فابل محافظة ذي قار، عام ٢٠١٩

**First: Cartographic representation of the average maximum temperature in winter for the three periods**

The maximum temperature means the highest temperature recorded during the day, as the radiation becomes positive in the period between the time of sunrise until the afternoon (Khalifa, 2021, 35), and the terrain on the one hand, the geographical location and the prevailing winds on the other hand play a major role in spatial and temporal changes. As for the maximum temperatures, the characteristics of the maximum temperature in Dhi Qar Governorate, the study area, can be studied by studying the characteristics of its distribution according to the four seasons, starting with winter.

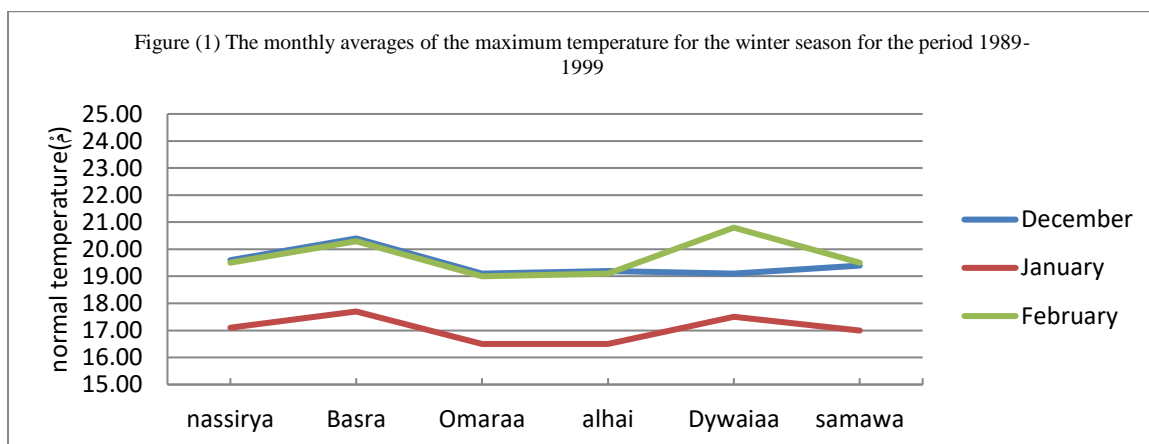
**Table (1) Average maximum temperatures during the winter season for the period 1989-2021**

Stations	(1999-1989) First period				(2010-2000) Second period				(2021-2011) Third period				an average of the season for three periods
	December	January	February	an average of the season	December	January	February	an average of the season	December	January	February	an average of the season	
Nassarya	19.6	17.1	19.5	18.7	20.0	17.7	21.7	19.8	20.4	19.5	22.0	20.6	19.7
Basra	20.4	17.7	20.3	19.5	20.3	18.2	22.1	20.2	21.1	20.1	22.6	21.2	20.3
Omaraa	19.1	16.5	19.0	18.2	19.2	16.8	21.0	19.0	20.4	18.5	21.2	20.0	19.1
Alhai	19.2	16.5	19.1	18.2	20.0	17.4	21.1	19.5	19.1	17.8	20.5	19.1	19.0
Dywaniyah	19.1	17.5	20.8	19.1	19.1	17.5	20.8	19.1	19.9	19.0	22.3	20.4	19.6
Samawa	19.4	17.0	19.5	18.6	19.6	16.6	21.3	19.2	19.8	18.6	21.3	19.9	19.2

**Source:** Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Department, unpublished data, 2021

**First term (1989-1999)**

It is clear from Table (1) that the average maximum temperatures vary in their seasonal rates at the level of the stations of the study area, as the stations of Basra and Diwaniyah recorded the highest degrees (19.5, 19.1 C), respectively, followed by Al-Nasiriyah station, with a seasonal average of (18.7 C). ) Samawah station recorded an average of (18.6 C) and the stations of Al-Amarah and Al-Hay were equal to the same quarterly average (18.2 C) for each of them. This temperature variation is reflected in the spatial variation and distribution of the maximum temperatures in the study area, due to the region being affected by the arrival of the continental polar air masses that reduce temperatures, in addition to the inclination of the sun's rays due to the astronomical location and the increase in the length of the night, which leads to heat loss through radiation. terrestrial during the long night with a few hours of actual sunshine, and this is related to the angle of incidence of the rays, which is a reflection of the apparent transition of the sun towards the south and the short length of the day and the effect of cold continental air masses. Originally few because of the few hours of radiation. As it appears from map (3) that the maximum temperatures decrease in the north and northeast and appeared in a light color in the first category, and rise towards the southeast in each of the districts of Al-Chibayish, Al-Fuhud and Al-Manar, which took a dark color in the last category.

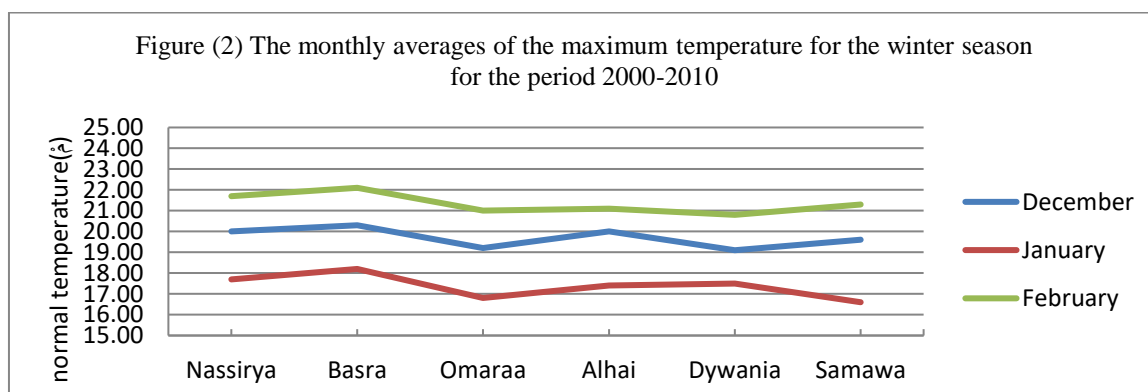


**Source:** The researcher's work based on the data of Table (1).

Figure (1) shows an increase in the average maximum temperatures for the winter season for the month of December. It rises in Basra station (20.4 °C), then it is followed by Nasiriyah station (19.6 °C), Samawah station (19.4 °C), Al-Hay station (19.2 °C), and Amarah and Samawah stations. The lowest rate was (19.1°C). In January, the temperature increased in Basra station (17.7°C), then Diwaniya station (17.5°C), Nasiriyah station (17.1°C), Samawah station (17.0°C), Al-Amara and Al-Hay stations recorded the lowest rate (16.5°C). In February, the average minimum temperature increased in Diwaniya station (20.8 °C), Basra station recorded (20.3 °C), Nasiriyah and Samawah stations recorded the same rate (19.5 °C), Al-Amarah station recorded (19.1 °C), and Al-Hay station recorded the lowest rate (19.0 °C).

## 2- The second term (2001-2010)

The data of Table (1) indicate that the average maximum temperature for winter in the second period is high in all stations. Therefore, Basra station ranked first with a seasonal rate of (20.2 °C) and Nasiriyah station recorded (19.8 °C). Then followed by the rest of the stations, which are (Samawah, Al-Hayy, Al-Amarah, Al-Diwaniyah) as their rates respectively reached (19.2, 18.3, 18.2, 18.0 m). The region of southern Iraq, which is characterized by the predominance of drought, high temperatures, the fall of sunlight at an angle close to the vertical, the increase in the number of daylight hours, and the number of hours of actual brightness due to the clearness of the air from clouds and the lack of atmospheric humidity, which leads to the arrival of the largest amount of solar radiation to the surface of the earth, and from Then the increase in heating, in addition to the dominance of the continental tropical air masses that raise the temperatures. Map (4) shows a decrease in temperatures in the north, Qalaat Sukkar and Al-Fajr, which took a light color in the first category, and the temperature gradually rises in the south of Al-Chibayish, Al-Fuhud, Al-Manar, Karmat Bani Said, and Al-Fadhliia, which appeared in a dark color in the last category.

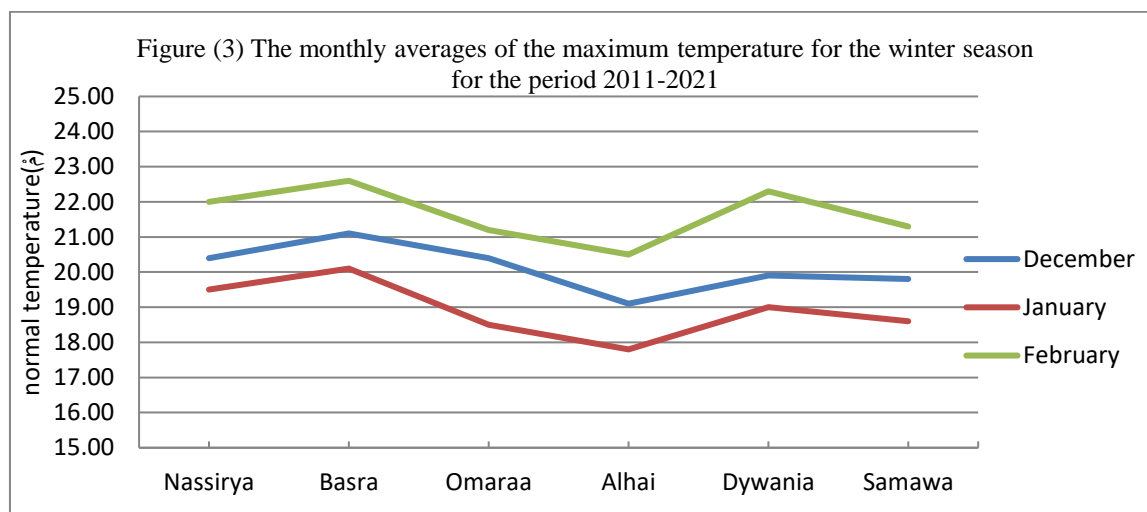


**Source:** The researcher's work based on the data of Table (1).

Figure (2) shows an increase in the average maximum temperatures for the winter season in December, rising in the Basra station (20.3 °C), then followed by the Nasiriyah and Al-Hay stations (20.0 °C), and the Samawah station recorded (19.6 °C), and the Amarah and Diwaniya stations converged (19.2, 19.1 °C). In January, the temperature rose in Basra station (18.2 °C), then Nasiriyah station (17.7 °C), Diwaniya and Al-Hay stations recorded (17.5, 17.4 °C), Amarah station recorded (16.8 °C), and Samawah station recorded the lowest rate (16.6 °C). In February The maximum temperature rates increased in Basra station (22.1 °C), Nasiriyah station recorded (21.7 °C), Samawah station recorded (21.3 °C), Al-Amara and Al-Hay stations converged (21.1, 21.0 °C), and Diwaniyah station recorded the lowest rate (20.8 °C).

**Third Term (2011-2021)**

It is noted from Table (1) that the maximum temperature rates in this period tend to increase more than the first and second periods in the climatic study area station and its supporting stations, as the Basra station recorded (21.2 °C), and this was the highest temperature recorded in this period, then Followed by the rest of the stations, which are Nasiriyah, Diwaniyah, Al-Amarah, Samawah and Al-Hay stations, as the average maximum temperatures were recorded (20.6, 20.4, 20.0, 19.9, 19.1) degrees Celsius, respectively. Perhaps here is an addition to the aforementioned influencing reasons. The temperature of the study area is the nature of the surface and its location in the sedimentary plain region, where the percentage of humidity and evaporation is high, as well as the dominance of the dry desert region and the impact of the continental air masses coming from the Arabian Gulf. Map (5) shows the decrease in temperature in the north of the study area and it gradually rises large in the south.

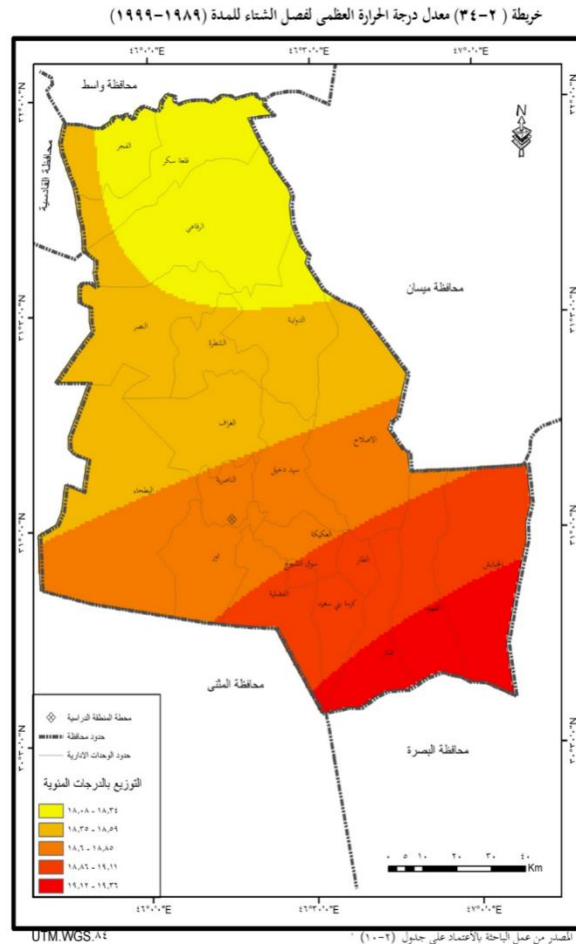


**Source:** The researcher's work based on the data of Table (1).

Figure (3) shows the increase in the average maximum temperatures for the winter season in December, rising in the Basra station (21.1 °C), and the station of Nasiriyah and Al-Amarah equaled (20.4 °C), and the stations of Diwaniya and Samawah were close to (19.8, 19.9 °C), and the Hay station recorded the lowest rate (19.1 °C). In January, the temperature increased in Basra station (20.1 C), then Nasiriyah station (19.5 C), Al-Diwaniyah station recorded (19.0 C), Samawah Al-Amarah station (18.6, 18.5 C) and Al-Hay station recorded the lowest rate (17.8 C). February The average maximum temperature increased in Basra station (22.6 °C), Diwaniyah station recorded (22.3 °C), Nasiriyah station recorded (22.0 °C), Samawah Al-Amarah station came close to (21.3, 21.2 °C), and Al-Hay station recorded the lowest rate (20.5 °C).

**3- Total term (1989-2021)**

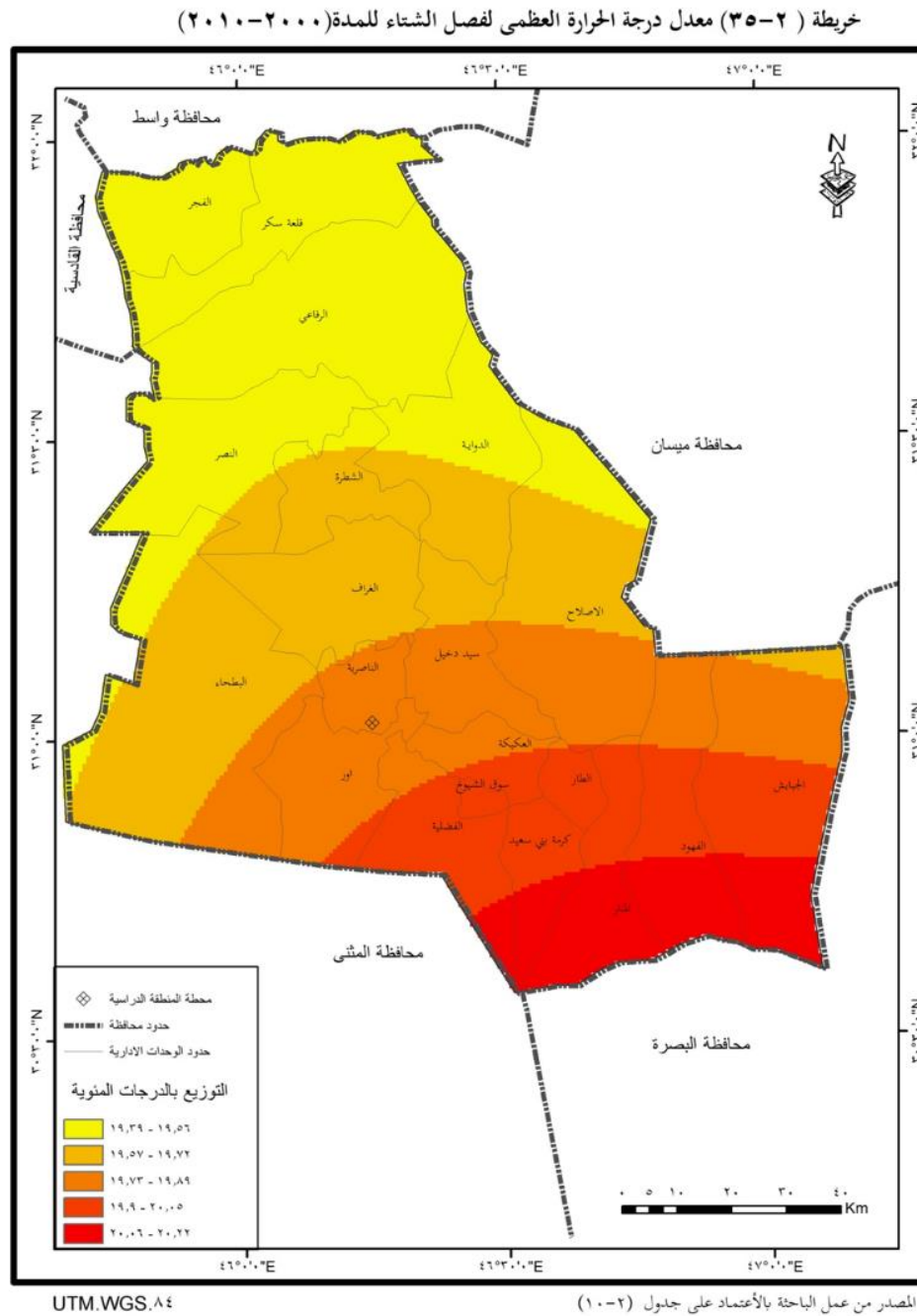
It is clear from Table (1) and Map (6) that the average maximum temperatures during the total period in the winter season tend to increase, as we note the following:



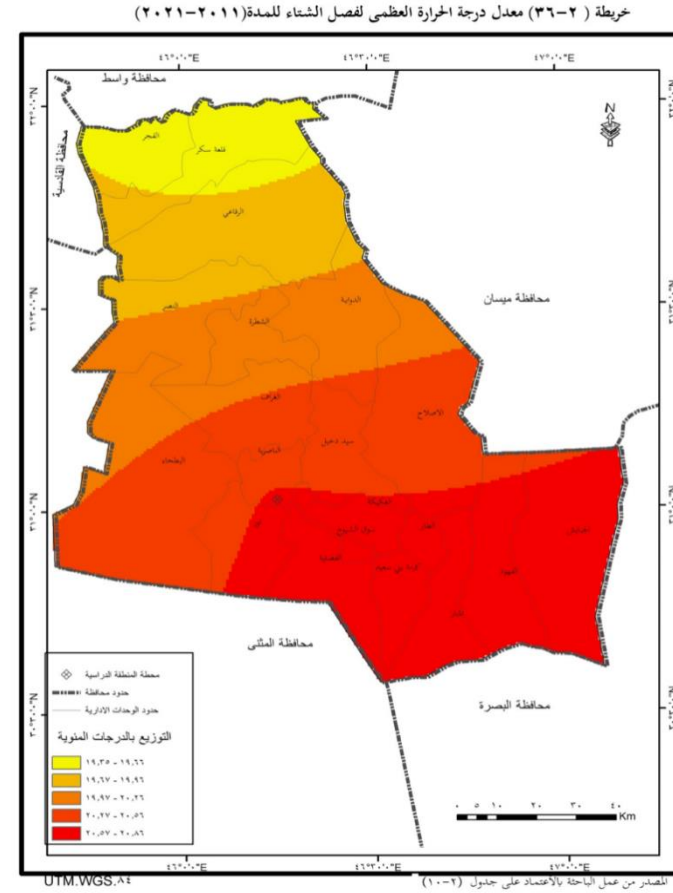
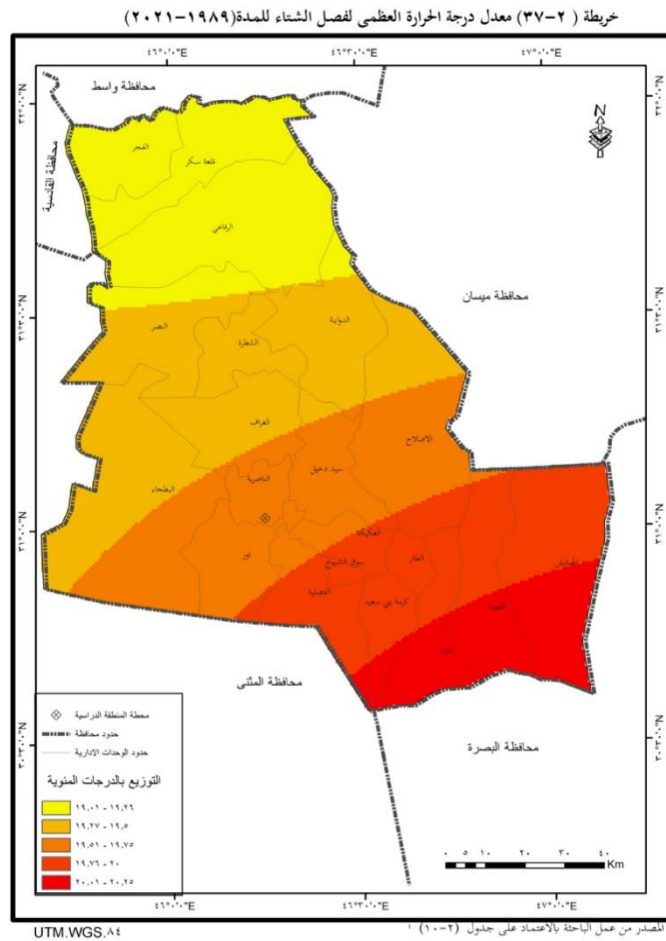
- 1- The Basra station took the lead in increasing the average maximum temperatures in the winter season, as the temperatures there reached (20.3 °C), and thus it occupied the leading position among the rest of the climatic stations in the three periods and the total period as well, due to the influence of the continental air masses coming from the Arabian Gulf. On it, as well as the southeastern winds blowing, which leads to high levels of humidity and increased evaporation, as well as the location of this station in the lands of the flat sedimentary plain and of little elevation.
- 2- Al-Hay station, located north of the study area, ranked last among the stations of the study area during the total period, as it recorded (19.0 C), which is the lowest average temperature among all stations. The reason for this may be due to the influence of the air masses coming from the Mediterranean.
- 3- Al-Amarah and Al-Samawah stations are also considered to be stations with a low maximum temperature in the winter season for the total period, as each of them recorded (19.2, 19.1 C).
- 4- As for the rest of the stations, Nasiriyah and Diwaniyah recorded the maximum temperatures in winter for the total period, respectively (19.7 and 19.6 C). These temperatures are considered high due to the lack of rainfall and the increase in

evaporation, as well as the location of the climatic stations in the plain. sedimentary, which is characterized by its simplicity and low elevation above sea level, as well as the predominance of the desert climate, which raises the temperature.

And through the cartographic analysis of the displacement of the great thermal regions in Dhi Qar Governorate, the study area for the three periods (1989-2021), it is shown that climate change takes the direction of the increase in temperature towards the south.







**Third: Cartographic representation of the average maximum temperature in the summer for the three periods**

The maximum temperatures rise significantly in all stations of the study area in this season and this rise as a result of the very large decline of the influence of the polar air masses coming from the north of the globe and the dominance of the continental masses CT that dominate the study area in the summer and the apparent movement of the sun towards the Tropic of Cancer.

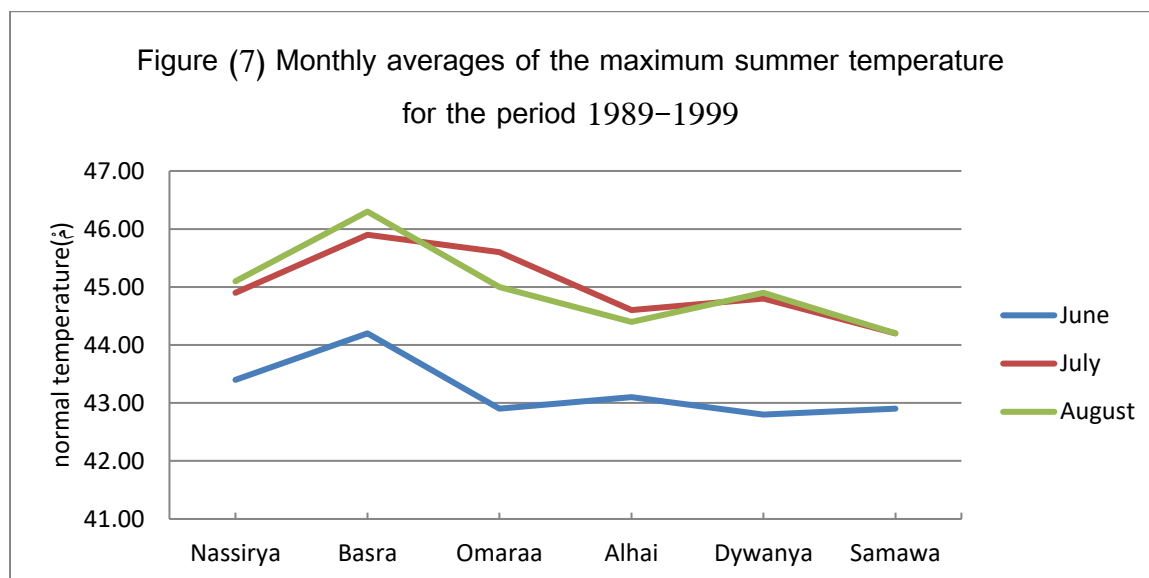
**Table (3)** Average summer maximum temperatures for the period 1989-2021

Stations	(1999-1989) First period				(2010-2000) Second period				(2021-2011) Third period				Season average for three periods
	June	July	August	Average season	June	July	August	Average season	June	July	August	Average season	
<b>Nassirya</b>	43.4	44.9	45.1	44.4	44.3	46.5	47.0	46.0	44.8	47.2	47.2	46.4	45.6
<b>Basra</b>	44.2	45.9	46.3	45.5	45.3	47.3	47.3	46.6	45.5	48.1	47.8	47.1	46.4
<b>Omaraa</b>	42.9	45.6	45.0	44.5	44.5	46.5	46.9	46.0	44.9	47.0	46.9	46.3	45.6
<b>alhai</b>	43.1	44.6	44.4	44.0	44.2	45.9	46.4	45.5	43.7	46.5	46.2	45.4	45.0
<b>Dywanya</b>	42.8	44.8	44.9	44.2	42.8	44.8	44.9	44.2	43.2	47.2	45.5	45.3	44.6
<b>Samawa</b>	42.9	44.2	44.2	43.8	43.6	44.9	45.1	44.5	43.7	46.0	46.0	45.2	44.5

**Source:** Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Department, unpublished data, 2021.

**First term (1989-1999)**

It is clear from Table (3) that the average maximum temperatures vary in their seasonal averages at the level of the stations of the study area, as the stations of Basra and Al-Amarah recorded the highest degrees (45.5 and 44.5 C), respectively, followed by Al-Nasiriyah station with a seasonal average of (44.4 m) Al-Diwaniyah and Al-Hay stations recorded an average of (44.2, 44.0 m) for each of them, and Samawah station recorded the lowest average (43.8 m). This variation in the maximum temperatures is reflected in the spatial variation and distribution of the maximum temperatures in the study area, as it is clear from map (11) that the maximum temperatures decrease in the north and include a large area in Qalaat Sukkar, Al-Fajr, Al-Rifai, and some sections of Al-Shatrah, Al-Dawaya, Al-Nasr, Al-Bathaa, Ur and Al-Gharf and are shown in color Al-Fateh is in the first category and gradually rises towards the south in both the districts of Al-Chibayish and Al-Fuhud, which took a dark color in the last category.



**Source:** *The researcher's work based on the data of Table (3).*

Figure (7) shows an increase in the average maximum temperatures for the summer in the month of June. It rises in Basra station (44.2 °C), Nasiriyah station (43.4 °C) and Al-Hay station (43.1 °C). Diwaniyah has the lowest average (42.8 °C), and in July the temperature increased in Basra station (45.9 °C), then after that Al-Amarah station (45.6 °C), Nasiriyah and Diwaniyah stations converged (44.9, 44.8 °C), Al-Hay station recorded (44.6 °C), and Samawah station recorded the lowest rate (44.2 °C). In August, the maximum temperatures increased in Basra station (46.3 °C), Nasiriyah and Amarah stations converged (45.1, 45.0 °C), Diwaniya station recorded (44.9 °C), Al-Hay station recorded (44.4 °C), and Samawah station recorded the lowest rate (44.2 °C).

## **2- The second term (2000-2010)**

The data of Table (3) indicate that the average maximum summer temperature in the second period is high in all stations. Therefore, Basra station topped with a seasonal rate of (46.6 °C), Nasiriyah and Al-Amarah stations recorded an equal rate of (46.0 °C), and Al-Hay station recorded (45.5 °C). Samawah station (44.5 °C) and Diwaniyah recorded the lowest rate (44.2 °C). The reason for this increase in seasonal averages is attributed to the fact that the main climatic station and the supporting stations used in the study are all located in the southern region of Iraq, which is characterized by the predominance of drought, high temperatures, and the incidence of sunlight at an angle close to the verticality, the increase in the number of daylight hours, and the number of hours of actual brightness due to the clearness of the air from the clouds and the lack of atmospheric humidity, which leads to the arrival of the largest amount of solar radiation to the surface of the earth, and then an increase in heating, in addition to the dominance of the continental tropical air masses that raise the temperatures. . Map (12) shows a decrease in temperatures in the north and northeast of Sukkar Castle, Al-Fajr, and some sections of Al-Rifai, Al-Bathaa, and Al-Nasr, which appeared in light color in the first category, and the temperature gradually rose until it rose in the south of Al-Chibayish, Al-Fuhud, and part of Al-Manar in the last category, which appeared in dark color.

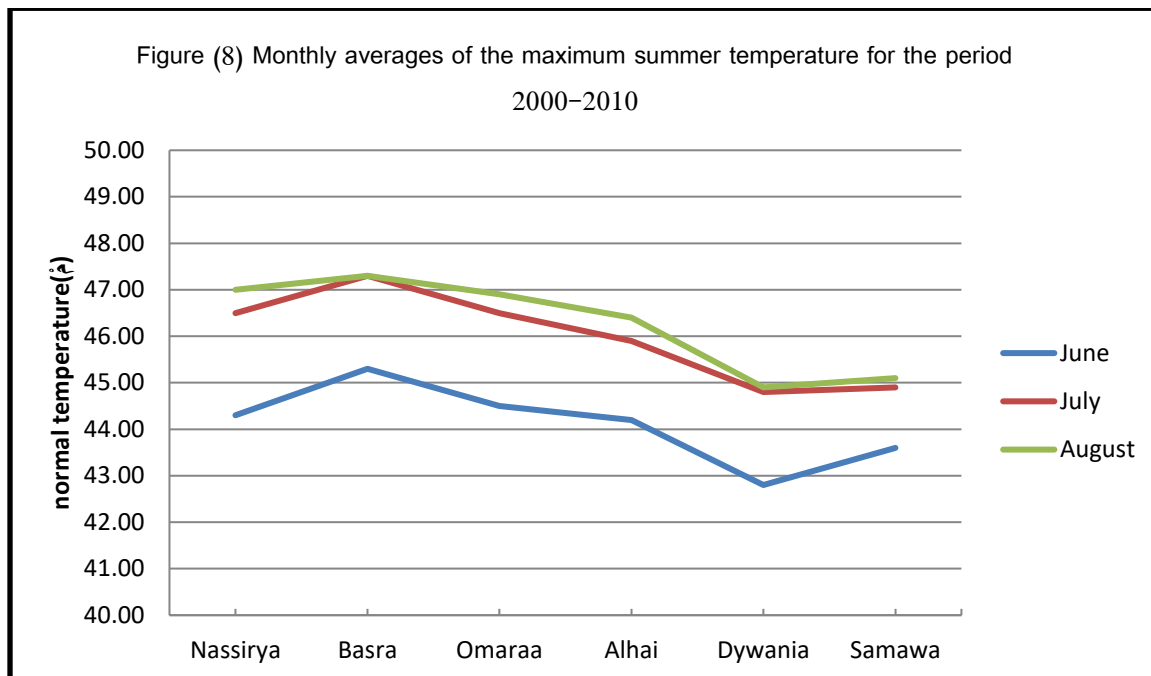


Figure (8) shows the increase in the average maximum temperatures for the summer in the month of June. It rises in the Basra station (45.3 °C), and the Amara station records (44.5 °C), and the Nasiriyah and Al-Hay stations converge (44.3,44.2 °C), and the Samawah station records (43.6 °C). Diwaniyah has the lowest rate (42.8 °C), and in July the temperature increased in Basra station (47.3 °C), and both Nasiriyah and Amarah stations were equal (46.5 °C), and the Hay station recorded (45.9 °C), and both Diwaniyah and Samawah stations were close to (44.8,44.9 °C). In August the maximum temperature rates increased in Basra station (47.3 °C), Nasiriyah station recorded (47.0 °C), Al-Amarah station recorded (46.9 °C), Al-Hay station recorded (46.4 °C), Samawah station recorded (45.1 °C), and Diwaniya station recorded the lowest rate (44.9 °C).

### 3- The third term (2000-2010)

As for the average maximum temperatures for summer in the third period, it is noted from Table (3) that the average maximum temperature in this period tends to increase more than the first and second periods in the climatic study area station and its supporting stations, as the Basra station recorded (47.1 °C). This was the highest temperature recorded during this period, then it was followed by the Nasiriyah station (46.4 °C), and the Amarah station recorded (46.3 °C). Al-Hay, Diwaniyah and Samawah stations were close (45.4, 45.3, 45.2 °C), and perhaps here is an addition to the aforementioned reasons affecting the temperature. The temperature of the study area is the nature of the surface and its location in the sedimentary plain region, where the percentage of humidity and evaporation is high, as well as the predominance of the dry desert region and the impact of the continental air masses coming from the Arabian Gulf. All these factors work to raise the temperatures in the stations of the study area (basic and supporting). Map (13) Low temperatures in the north of Qalaat Sukkar and Al-Fajr, which appeared in the light color in the first category, and their rise in the south in Al-Chibayish, Al-Fuhud, and Al-Manar, which took a dark color in the last category.

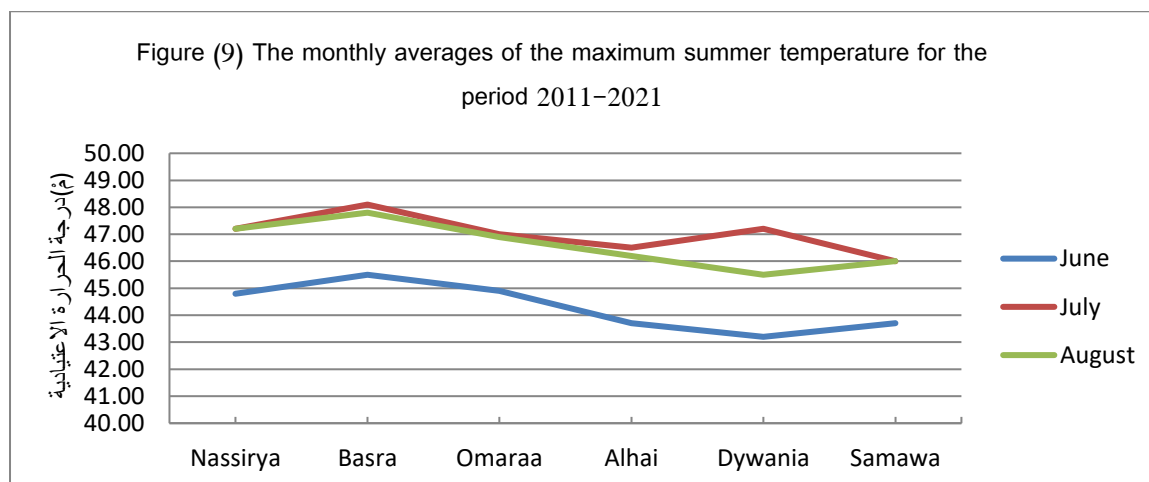


Figure (9) shows an increase in the average maximum temperatures for the summer in the month of June. It rises in the Basra station (45.5 °C), and the stations of Amarah and Nasiriyah recorded (44.9, 44.8 °C), while the Hay and Samawah stations are equal (43.7 °C), and the Diwaniya station records the lowest average (43.2 °C). In July, the temperature increased in Basra station (48.1 °C), Nasiriyah and Diwaniya stations were equal (47.2 °C), Al-Amarah station recorded (47.0 °C), Al-Hay station recorded (46.5 °C), and Samawah station recorded the lowest rate (46.0 °C). The maximum temperature in Basra station was (47.8 C), Nasiriyah station recorded (47.2 C), Al-Amarah station recorded (46.9 C), Al-Hay station recorded (46.2 C), Al-Samawah station recorded (46.0 C), and Diwaniya station recorded the lowest rate (45.5 C)..

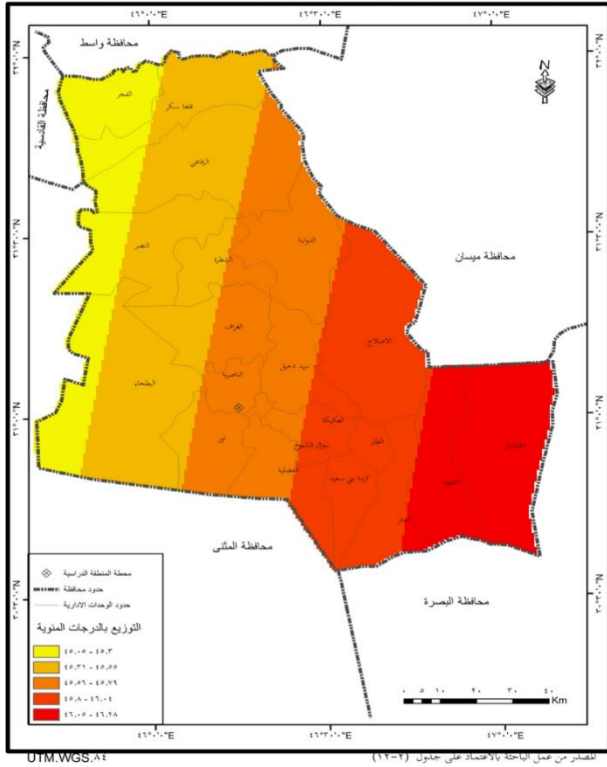
#### 4- Total period (1989-2021)

It is clear from Table (3) and Map (14) that the average maximum temperatures during the total period in the summer season tend to increase, as we note the following:

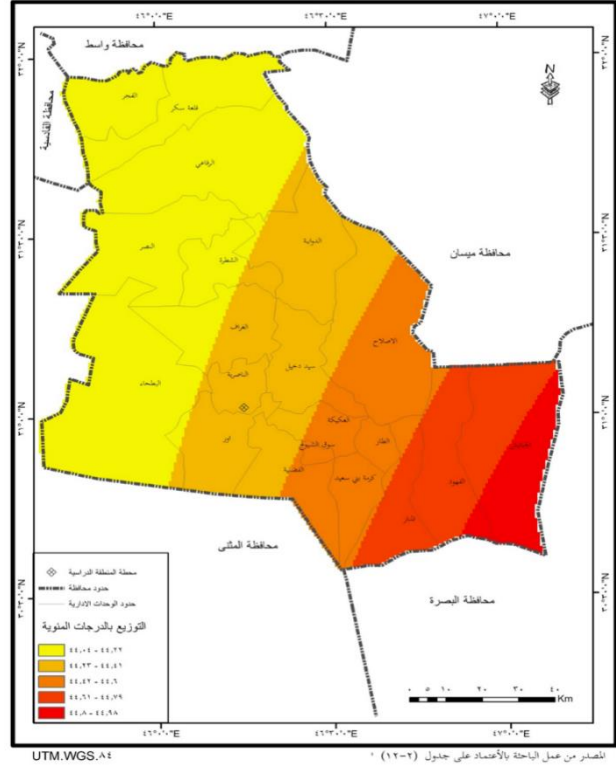
- 1- The Basra station took the lead in increasing the maximum temperatures in the summer, as the temperatures there reached (46.4 °C), and thus it occupied the leading position among the rest of the climatic stations in the three periods and the total period as well, due to the influence of the continental air masses coming from the Arabian Gulf. On it, as well as the southeastern winds blowing, which leads to high levels of humidity and increased evaporation, as well as the location of this station in the lands of the flat sedimentary plain and a little higher than sea level.
- 2- The Samawah station ranked last among the stations of the study area during the total period, as it recorded (44.5 C), which is the lowest average temperature among all stations, and the reason for this may be due to the influence of the air masses coming from the Mediterranean.
- 3- Al-Diwaniya station is also considered as the lowest maximum temperature station in the summer for the total period, as each of them recorded (44.6 C).
- 4- As for the rest of the stations, both Nasiriyah and Al-Hay recorded the maximum temperatures in the summer for the total period of (45.6 C) and Al-Hay station recorded (45.0 C). These temperatures are considered high due to the low amount of rain falling and the increase in evaporation, as well as the location of the climatic stations in The sedimentary plain, which is characterized by its simplicity and low elevation above sea level, as well as the predominance of the desert climate, which raises temperatures.

And through the cartographic analysis of the displacement of the great thermal regions in Dhi Qar Governorate, the study area for the three periods (1989-2021), it is shown that climate change takes the direction of the increase in temperature towards the south.

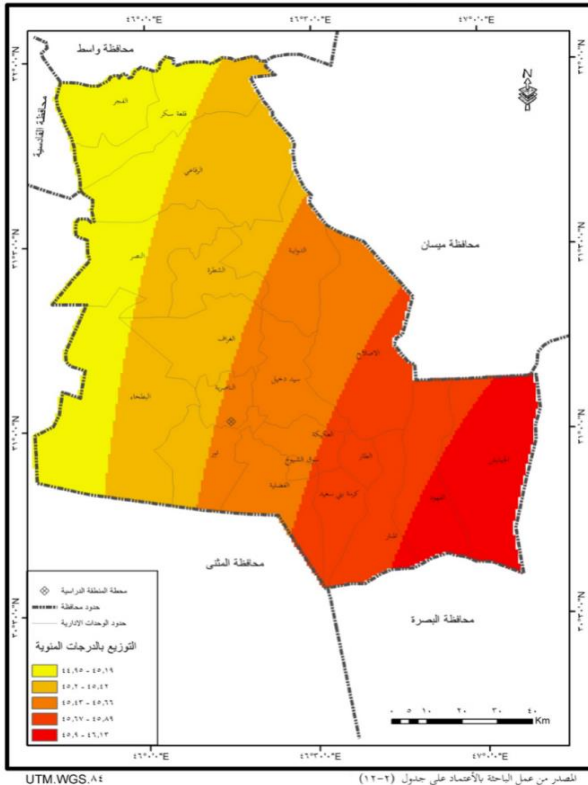
خريطة (٤٣-٢) معدل درجة الحرارة العظمى لفصل الصيف للمدة (٢٠٠٠-٢٠١٠)



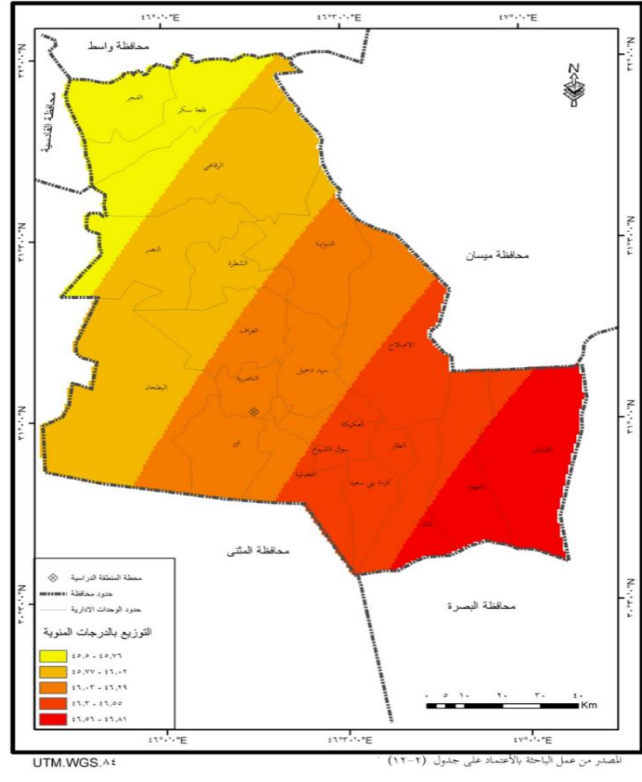
خريطة (٤٢-٢) معدل درجة الحرارة العظمى لفصل الصيف للمدة (١٩٨٩-١٩٩٩)



خريطة (٤٥-٢) معدل درجة الحرارة العظمى لفصل الصيف للمدة (١٩٨٩-٢٠٢١)



خريطة (٤٤-٢) معدل درجة الحرارة العظمى لفصل الصيف للمدة (٢٠١١-٢٠٢١)



## Conclusions

The study reached a number of conclusions, the most important of which are:

The variation of the maximum temperature rates in Dhi Qar governorate, as it was shown from the cartographic models five super thermal regions whose temperature in the winter season ranged between (18.08-19.36 C), and the second period ranged between (19.39-20.22 C), and the third period ( 19.35\_20.86°C), and the total duration of the study ranged from (19.01\_20.25°C) to its regions. In the spring, the thermal regions varied between (31.49\_31.75 C) in the first period, and the second period (32.94\_33.7 C), while the third period varied between (32.9\_33.26 C), while the total period was (31.59\_33). ,36 m). The summer season varied in the first period (44.04\_44.98m), the second period (45.05\_46.28m), and the third period (45.5\_46.81m), while the total period was (44.95\_46.13m), and the autumn season recorded a variation in Its thermal regions, as the first period varied between (34.2\_35.15C), with a variation rate of (34.56\_35.41C) in the second period, and the third period recorded a variation of (34.45\_36.3C), and the total duration of the semester was (34.51\_35.79C). .

## Suggestions

- 1- Studying the shift of thermal regions using modern spatial techniques in other parts of Iraq using modern spatial mapping and in-depth knowledge of its causes and effects because it is considered one of the important topics at the global level.
- 2- The need to expand the establishment of climatic stations in addition to the current stations in order to increase the accuracy of the results that can be reached by the various climate studies, especially studies similar to ours, as they depend on spatial interpolation techniques in geographic information systems.

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