



## The Impact of the Extreme Air Temperatures on the Characteristics of Iraq Weather

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### Abstract

Air Temperature is mainly affect the condition of temporal and spatial weather. This influence may be very high on some weather variables such as pressure, humidity and winds, also the Extreme of these variables can be considered as an indicator of the impact and intensity of the pressure systems. The data of the European Centre for Medium-Range Weather Forecasts (ECMWF) during the summer months (June, July and August) of the period (2006 - 2017) were used to extract the Extreme of Daily Maximum Temperatures (EDMT) for four stations in Iraq (Baghdad, Basra, Khanaqin and AL-Rutba). The results that the number of extreme cases characteristics is nine, one of which is the beginning of the season, and the other was the end of the summer season and this confirms the stretch of the summer about a month May and September. This was done by considering 50°C/323°K as the most extreme values of two stations, and finding other extreme values for each region based on the maximum Temperatures anomalies. However, we must mention the geographical impact of (EDMT) and thus on the changing trajectory of the recipes of pressure pattern.

**Keywords:** Air temperature, Extreme daily maximum temperature, Anomaly temperature, Extreme cases.

### تأثير درجات الحرارة المتطرفة على خصائص طقس العراق

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### الخلاصة

درجة حرارة الهواء تؤثر بشكل اساسي على حالة الطقس الزماني والمكاني، وقد يكون هذا التأثير كبيرا جدا على بعض المتغيرات الأنوائية مثل الضغط الجوي والرطوبة والرياح ، لذا يمكن اعتبار تطرف هذا المتغير كمؤشر لتأثير المنظومة الضغطية وشدها. تم استخدام بيانات المركز الاوربي لتنبؤات بالطقس متوسطة المدى (ECMWF) للفترة (2006-2017) ولأشهر فصل الصيف ( حزيران ، تموز ، آب) و استخراج القيم المتطرفة لدرجات الحرارة العظمى اليومية لأربع محطات في العراق (بغداد - البصرة - خانقين - الرطبة) لغرض تحديد اعلى حالات تطرف شهدتها المنطقة في فترة الدراسة والتي اثرت على معظم المحطات او جميعها، كانت النتيجة بان عدد الحالات المتطرفة المميزة لأربع محطات هي تسع حالات منها واحدة بداية موسم الصيف ، وواحدة كانت نهاية موسم الصيف وهذا يؤكد تمدد هذا الفصل نحو شهري آيار وابلول . تم ذلك من خلال اعتبار (50°سيليزية/323°كلفن) هي ابرز قيم التطرف لمحطتين ، وايجاد قيم تطرف اخرى خاصة لكل منطقة بالاعتماد على شذوذ درجة الحرارة العظمى، مع هذا لا بد ان نذكر التأثير الجغرافي على التطرف اليومي لدرجات الحرارة وبالتالي التأثير على تغير مسار وصفات الانماط الضغطية.

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## 1. Introduction

The air temperature is a measured of the atmospheric temperatures, It is the result of the absorption of solar radiation by the surface of the earth. The Surface Air Temperature (SAT) is observing air temperature at 2 meter above the earth surface; they also represent some effects which humans are exposed [1]. Its record in many times so the maximum temperature is the highest temperature recorded, during (24) hours in a particular area, accurate electric device were used, in the summer recorded between three and fourth p.m. in the winter recorded at one or two afternoons. But the minimum temperature is the lowest temperature recorded during (24) hours in an area, It is usually read in the accompanying period before the sunrise between the fifth and seventh Hours, according to the change of seasons, in the summer it records at the fifth O'clock also in winter it record at the seventh O'clock. Surface air temperature may record values more than the maximum temperature for a given period, that is extreme temperature, is an event which the daily mean of (maximum or minimum) temperature will be (increase or decrease) equivalent to (5degree) for a period not exceeding 3 days[2]. The extreme temperatures divided into two types, hot extreme that the daily temperatures have exceed the average over 10°C, and the cold extreme that below of average. The long term of extreme events that great effect on the human and other living organisms. The Extreme events of daily temperatures are associated with events of other meteorological elements, as affected by the pressure patterns and their impact on the weather in general[3]. Geographic influences are also important for the study of extremes Temperature, Such as the impact of the weather and climate on some areas of Iraq within the sedimentary plain and desert areas are very hot.

## 2. The Previous Studies

The Study of M. Demirtas 2018, "The high-impact 2007 hot summer over turkey: atmospheric-blocking and heat wave episodes". which included was high Effect of heat waves on Balkans and Turkey during summer 2007. The extreme heat cases associated with many factors. The Result from this research indicate that the atmospheric blocking was responsible for foundation and maintaining the hot-weather cases, The summer of 2007 may be considered as a strong indicator of what Turkish summers may become in future[4]. The purpose of study for M. Darand. et.al 2017, "Synoptic conditions leading to extremely warm periods in Western Iran" , To identify the correlation relationship between characteristic of pressure pattern in synoptic scale and the period of extreme warm over Areas of Kurdistan Iran, result, The spring pattern is the most frequent one (nearly 48% of all cases) and reflects a southeastward extension of the subpolar low pressure that leads to the displacement of the Siberian high to south and southwestern Asia and the accompanied northward expansion of the Sudan low[5]. The study of Peter A. Bieniek and John E. Walsh 2017 "Atmospheric circulation patterns associated with monthly and daily temperature and precipitation extremes in Alaska" the temporal variations and trends of monthly and daily temperature and precipitation extremes in Alaska, and the synoptic-scale circulation patterns associated with these extremes, Composite SLP fields for daily and monthly extremes are similar, especially in winter, indicating that monthly extremes represent the recurrence of daily extreme patterns during[6]. Paul C. Loikith and Anthony J. Broccoli 2012 were study "Characteristics of Observed Atmospheric Circulation Patterns Associated with Temperature Extremes over North America" they result show that warm extremes at most locations are associated with positive 500-hPa geopotential height and sea level pressure anomalies just downstream with negative anomalies farther upstream Circulation patterns aloft are more coherent across the continent than those at the surface where local surface features influence the occurrence of and patterns associated with extreme temperature days. Temperature extremes may be more sensitive to small shifts in circulation at locations where temperature is strongly influenced by mountains or large water bodies [7].

## 3. Methods and dataset

Study of daily maximum temperatures for the four stations (Baghdad, Basra, Khanaqin and Rutba) of Iraq, which located in southwest Asia, between longitudes (38°45' - 48° 45')E and latitudes (29°5' - 37°22')N. The total of Iraq area is 438317 km<sup>2</sup>, surrounded by mountains in the east and north, which reaches their altitudes of 3611m above sea level, but the south and west consisting of desert areas. The variety of Iraq's landscape leads to a variety of climates [8]. Baghdad city is located in the center of Iraq, the capital, it's situated with geographic coordinates, longitudes 44°24' E, latitudes 33°18' N, this city altitude is 32 m above sea level[9]. Second station is Basra city which located in the south of Iraq within the coordinates (longitudes 47°49' E and latitudes 30°30' N) is bordered to the east by the

Iranian city of Abadan and the south by the State of Kuwait. The region of the confluence of the Tigris and Euphrates, which is only 5 meters above sea level[10]. Khanaqin is a city center of Diyala province in the eastern of Iraq, northeast of Baghdad city, bordered to the east by the Iraqi-Iranian border and to the north by Sulaymaniyah. Khanaqin station is located at the coordinates of (longitude 45°26'E and latitude 34°18' N), the altitude of the sea level is 200 meters. AL-Rutba is a city center of AL-Anbar province that located in the western of Iraq, the region of this city at coordinates (longitude 40°37' E, latitude 32°02' N), altitude of this area is 645 meters above sea level. Bordered by Saudi Arabia from the southern - west, Jordan from the west, and Syrian republic from the northern-west [11]

In this study, the data of maximum temperature 2 meters have been used to found characteristics of extreme daily maximum temperatures , recent and reliable data are the basis for any study in atmospheric science, so these data is not easy, the more important is how to handle these data correctly, in this study, the data source of (ECMWF) was adopted for summer seasons (Jun – July – August) the period (2007- 2017), the data of this center were re-analyzed. So they are not original values. The average of (DMT) for 12 seasons of each station has been calculated using the temperatures average equation [12]:

$$\bar{X} = \sum_i^n X/N \quad \dots\dots\dots (1)$$

To extract anomaly, the anomaly equation have been used [13]:

$$\text{Anomaly}(X) = X_i - \bar{X} \quad \dots\dots\dots (2)$$

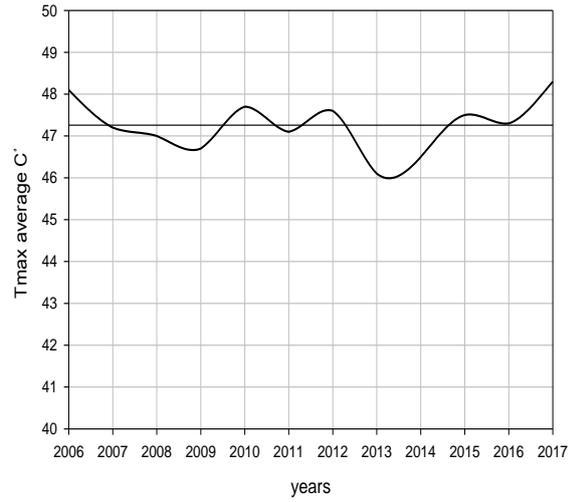
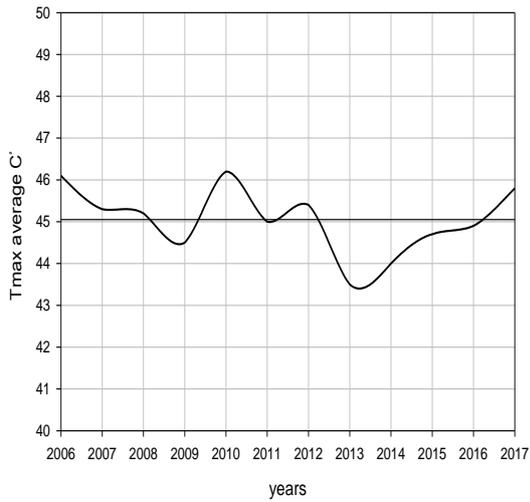
Where:  $X_i$ = Daily Maximum Temperature (DMT)

$\bar{X}$ = Average of (DMT ) for twelve summer seasons

Data values vary from one region to another from the general average, this difference may be positive or negative, it was assumed that the values of extreme were higher than the anomalies by 2°C, Thus , the extreme DMT more than the average by 4 °C. So each stations has particularly extreme temperatures, this is in addition to the fixed degree of extreme that have been identified for some regions 50°C/323°K.

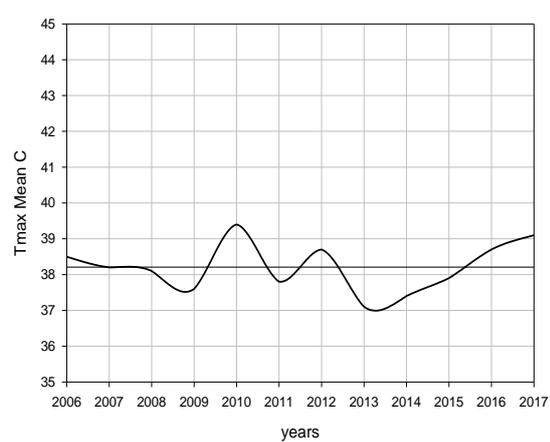
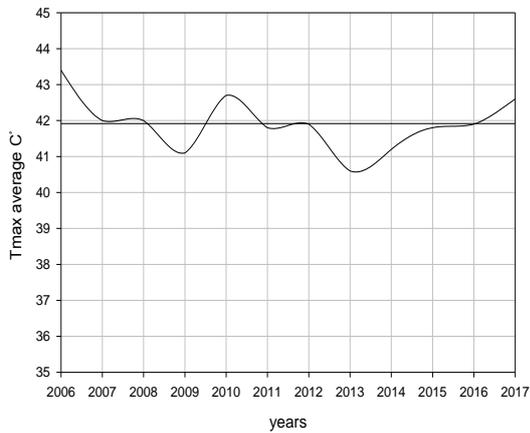
#### 4. Results and discussions:

The good results come from good predictability of extreme DMT that was based on anomaly method. When DMT was equal to 50°C/323°K that represent critical point; the extreme event that equal or more than critical point. Some of events take one day, others take two or three days. The normally some of extreme events happen in mid of summer season, but there several cause take place in beginning and end of season, therefor, summer season divided into three interval time (beginning, mid , end). Baghdad station recorded ten events/19 days, Basra station had more chance of events that take a more than forty-seven events which equal 50°C/323°K into twelve summer seasons. The other type of extreme DMT , which record by calculated maximum temperature average for any region by the average temperature equation(1), as a Figure-1, and find the anomaly by temperature anomaly equation(2), as shown in Table-1. From these type of extreme DMT, Baghdad station recorded twenty-seven events that include one in beginning and eight into end of summer seasons. But Basra station recorded thirteen event, it have one event in beginning and no events into the end of summer seasons. Khanaqin station recorded twenty-eight events of extreme DMT, one event in beginning and three events in the end of summer seasons. Also the Rutba station recorded thirty-six events, it have two events into beginning and ten events into the end of summer seasons during study period.



(a)

(b)



(c)

(d)

**Figure1**-Illustrate the average (DMT) values during summer seasons of the 12 years for the four stations (a) Baghdad, (b) Basra, (c) Khanaqin and (d) Rutba

The value of the averages, anomalies and extreme temperatures can be illustrated in the T-able-1:

**Table1**-Represent all studies stations and the values of average, anomalies and extreme for temperatures into 12 summer seasons.

Stations	Average	Anomaly	Extreme
Baghdad	45	47	49
Basra	47	49	51
Khanaqin	42	44	46
Rutba	38	40	42

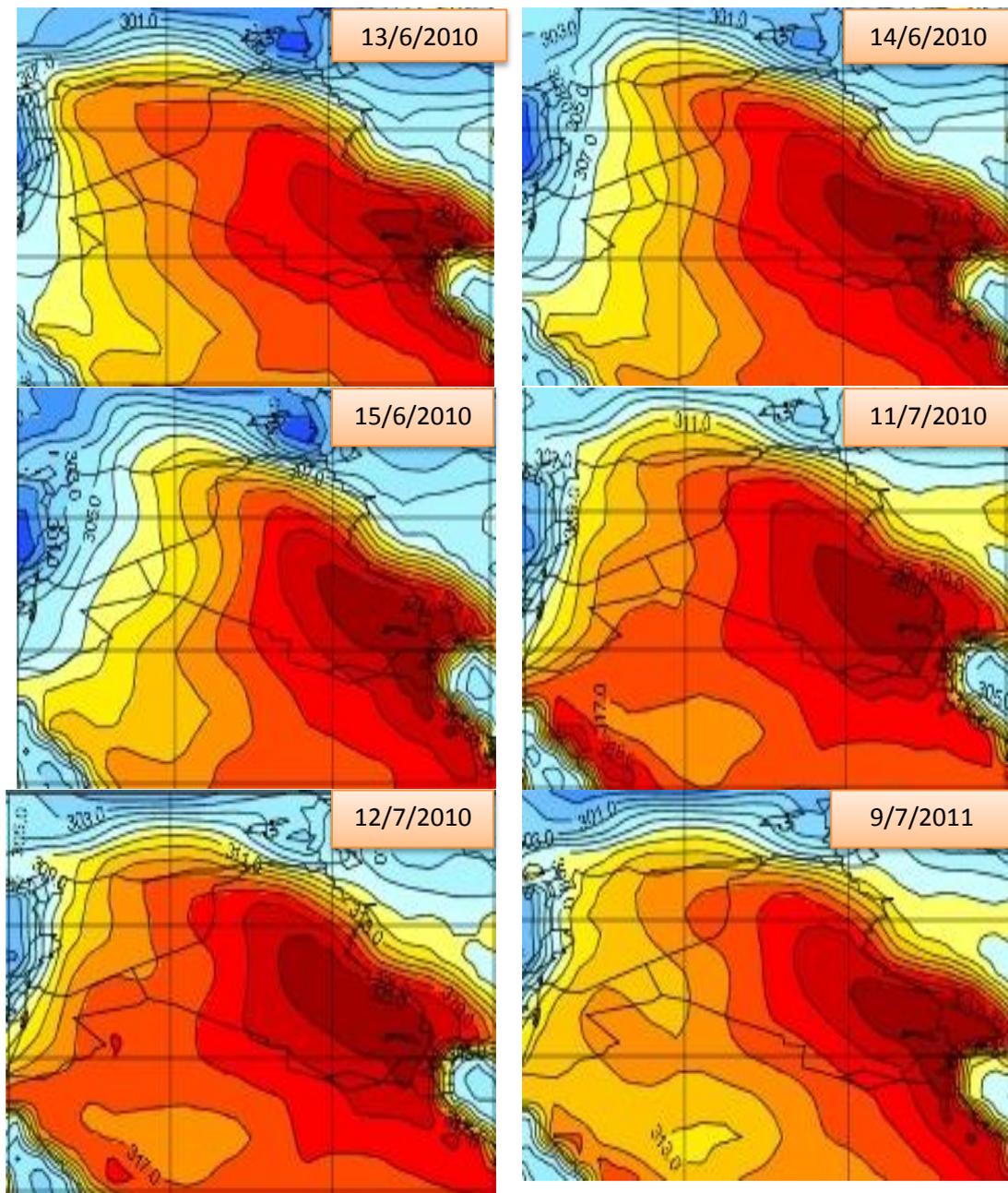
**EDMT Events of the Studied Stations at the same time:**

When comparing the extreme  $T_{max}$  events for the four chosen stations, selected distinctive events which occur in same time (common events) which call is (Case). Table-2 show these cases, when B- beginning, C-Center, E- End of Season:

**Table2-**Present the cases of the strongest extreme conditions.

No.	Event's Date	Event describe	No.	Event's Date	Event describe
1	13 - 15/6/2010	3 days/ B	6	30/7/2015	1 day/ C
2	11 - 12/7/2010	2 days/ C	7	21/8/2015	1 day/ E
3	9/7/2011	1 day/ C	8	18/7/2017	1 day/ C
4	28 – 31/7/2011	4 days/ C	9	8 – 10/8/2017	3 days/ C
5	20 – 25/7/2012	6 days/ C			

To simplify that influence for the extreme cases, the selected cases were Figure-5 (do not exceed three days) by a set of contour maps that show daily maximum temperatures (DMT) for the studied area that extended between (longitude 35° –50° E) and (latitude 25° – 40° N), the scale of maximum temperature showed in maps were (Kelvin) degree. No.(4,5) from the table(2) considered a heat wave and according to the conditions of the heat waves and not extreme cases because they exceeded three day.



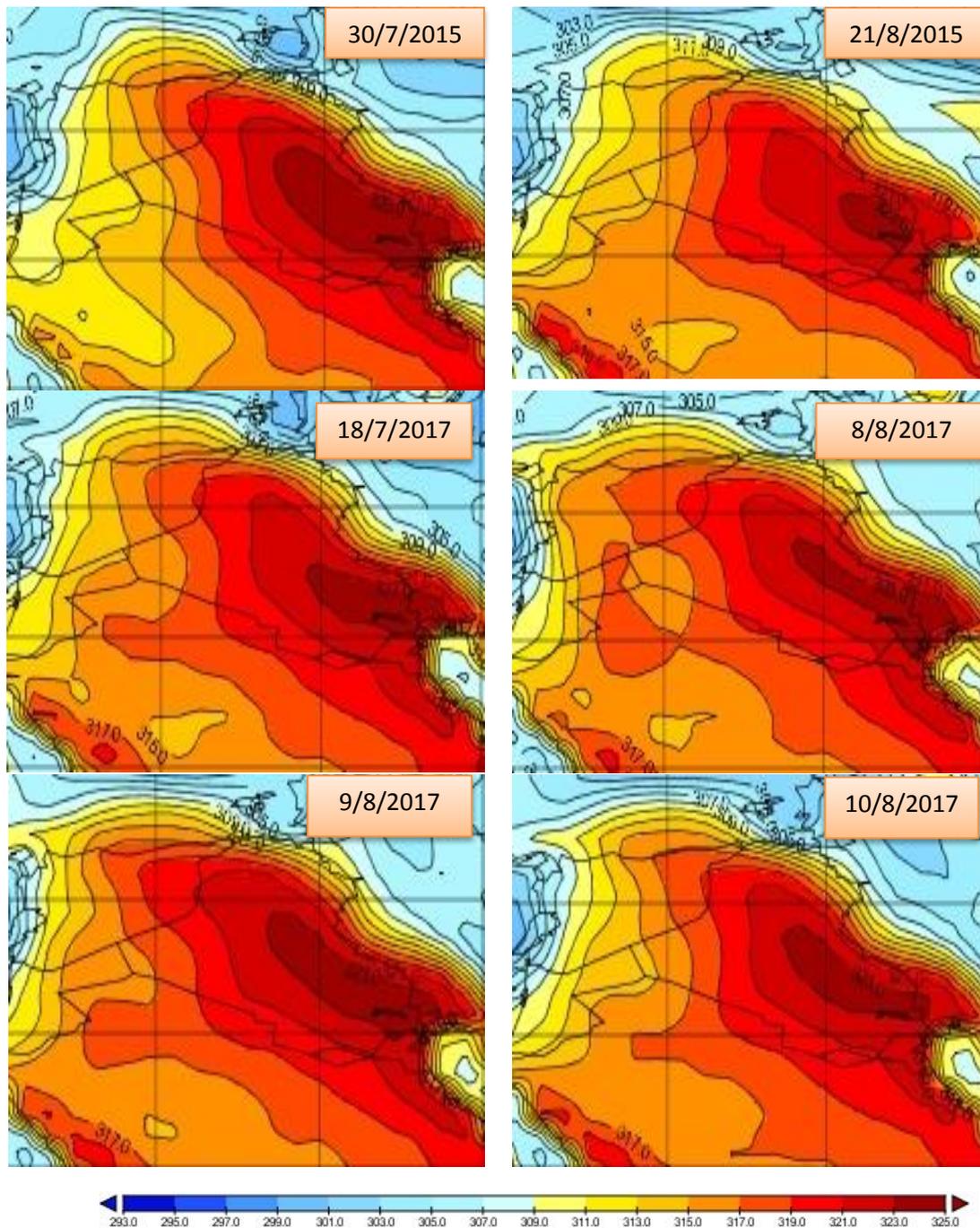


Figure 2- Extreme DMT which impact on all study stations shown with (Kelvin) scale

#### 4. Conclusions

1. Analysis of daily maximum temperatures (DMT) when reach to  $50^{\circ}\text{C}/323^{\circ}\text{K}$  or more for Iraq especial of southern parts, that record 70 events , 60 events for Basra city. Some events over take a day and often take 3 days.
2. Baghdad not record between (2006 – 2009), it not signal at beginning and end of summer seasons.
3. Another way to calculate extreme DMT, was by using anomaly method, by this cases each region has own value of anomaly. depended on the general average of maximum temperatures cause it differ from region to other and according to geographical and climatic diversity.
4. The extreme cases were found in the end of summer seasons by four time then beginning. This accentual that the summer season was extend to September more than May moth.

## 5. References

1. Ahrens, C. D. **2011**. *Essentials of Meteorology, An Invitation to the Atmosphere*, Third Edition, pp.454.
2. Muter, S.A. **2014**. Variability of daily Maximum and Minimum Temperature for summer Seasons in Baghdad City. Master thesis, the college of science, Mustansiriyah University, Baghdad, Iraq. pp .86.
3. Diaz, H.F. and Richard J.M. **2008**. *Climate Extremes and Society*, Cambridge University Press, pp.339.
4. Demirtas, M. **2018**. The High-Impact 2007 Hot Summer over Turkey: Atmospheric – Blocking and Heat – Wave Episodes, Meteorological Applications. *Royal Meteorological Society*, **25**(1). DOI: 10.1002/met.1708.
5. Darand, M., R G.H., H A., R A. and David B. **2017**. Synoptic Conditions leading to Extremely Warm periods in Western Iran. *International Journal of climatology*, **38**(1):.307–319. DOI: 10.1002/joc.5177
6. Bieniek, P.A., and John E.W. **2017**. Atmospheric Circulation Patterns Associated with Monthly and Daily Temperature and Precipitation Extremes in Alaska. *Royal Meteorological Society, International journal of Climatology*, **37**(S1): 208 – 217. DOI:10.1002/joc.4994
7. Loikith, P.C. and Anthony J.B. **2012**. Characteristics of Observed Atmospheric Circulation Patterns Associated with Temperature Extremes over North America. *Journal of Climate, American Meteorological Society*, **25**: 7266–7281. DOI: 10.1175/JCLI-D-11-00709.1.
8. Robaa, S.M. and Zhian J.A. **2013**. Trends of Annual Mean Surface Air Temperature over Iraq. *Nature and Science*, **11**: 138 – 145.
9. Bilal, D.A., Kais J.A., and Enas A.H. **2013**. Air temperature Trends in Baghdad, Iraq for the Period 1941–2000. *International Journal of Scientific and Research Publications*, **3**(9): 01-05.
10. Abd-Alwahab, W.A. **2014**. *Pressure Systems and their Impact on Changing the Degree of Continental Climate of Iraq*, Master Thesis, Geographic Dept., College of Education, University of Baghdad, Baghdad, Iraq. pp.163.
11. AL-juboori, M.H. and Sana A.A. **2010**. *Practical experiments in atmospheric monitoring, analysis and prediction*, Egypt Mortada Book Association, pp.284.
12. Zeki, Kh.N. **2017**. Effect of Maximum Air Temperature on the Monthly Average Temperature and the Comfortable of Human in Baghdad Station. *College of Education Journal*, **2**(2): 389- 406.
13. Alhashimi, A.K. **2017**. *Determination of Temperature Difference Between Urban and Rural area for Baghdad City*, Master Thesis, College of Science, Mustansiriyah University, Baghdad, Iraq, pp.82.