

Air Temperature Variation between Basra city center and its Northern West Side

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Abstract

We investigate the effect of urban and the surrounding desert areas from the west and northern west side on the temperature of the city, and to find out the difference between them for both maximum temperatures and minimum. It was based on the data of the Iraqi Meteorological Organization, and Seismology for both Al Hussein Station and Basra Airport station for the period from 1990 to 2012. The result was that the difference average in the maximum temperature between the two stations very low and did not exceed 0.3 °C. In some months, the maximum temperature of Al Hussein Station was higher than the maximum temperature of airport station. The difference average in temperature extremes was clear as it exceeded 3°C in July and October.

Keywords: Air Temperature; Basra City; Urban; Desert areas

تباين درجة حرارة الهواء بين مدينة البصرة وجانبها الشمالي الغربي

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الخلاصة

اهتم هذا البحث بدراسة تأثير التحضر والمناطق الصحراوية المحيطة بها من الجانب الغربي والشمال الغربي على درجة حرارة المدينة ومعرفة مدى الفرق بينهما لكل من درجات الحرارة العظمى والصغرى. حيث اعتمد على بيانات الهيئة العامة للأحوال الجوية والرصد الزلزالي لكل من محطة الحسين ومطار البصرة للفترة من 1990 الى 2012. كانت النتيجة ان معدل الفرق في درجات الحرارة العظمى بين المحطتين قليل جدا لم تصل 0.3°C فضلا ان في بعض الأشهر كانت درجة حرارة محطة المطار اعلى من محطة الحسين. اما معدل الفرق في درجات الحرارة العظمى فقد كان واضحا حيث و في شهري تموز وتشرين الأول 3°C .

الكلمات المفتاحية: درجة الحرارة، مدينة البصرة، التحضر، المناطق الصحراوية

1- Introduction

The temperature of air is one of the most important parameter of the atmosphere; this is because of its huge effects on climatic variables and the climate system, and also one of the factors that impact on human life [1]. Many factors lead to increase the temperature. Environmental deterioration and intensive deforestation caused by industrialization, war, urbanization, and natural disasters, for example flooding and drought due to global warming are becoming increasingly common [2]. Cities become an important factor in changing the local climate case, resulting from the large number of the inhabitants of the city, the multiplicity of factories and a large number of vehicles in the streets, the high temperature of the air over the city and the areas surrounding it [3]. Urbanization is one of the most obvious examples of human amendment of the earth's surface. Although it covers only 1.2% of the Earth's surface, and it is estimated approximately 48% of the world population in 2003, lies in the urban settlements [4]. The world urban population is predicted to increase by 72 % by 2050, from 3.6 billion people in 2011 to 6.3 billion in 2050 [5]. In figure (1), we can see the reasonably constant weather; the heat island intensity varies in a recognizable way during the daytime. The most notable feature is that the lower cooling in the urban area in the late afternoon and evening results in a higher nocturnal minimum temperature in the city. The urban area is slower to warm up after sunrise. The intensity is usually declines slightly through the rest of the night and is rapidly eroded after sunrise [6].

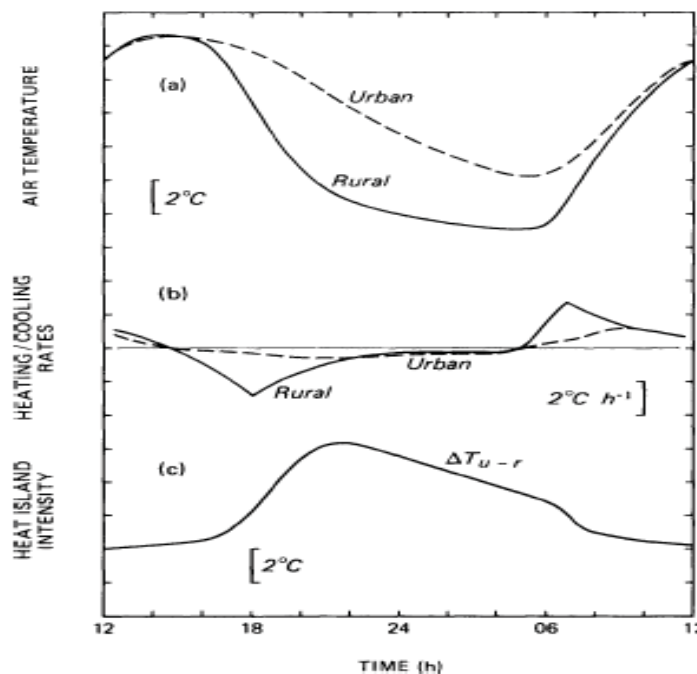


Fig.(1): Typical temporal variation of urban and rural (a) air temperature and (b) cooling/warming rates and (c) the resulting heat island intensity (ΔT_{u-r}) under 'ideal' weather conditions [6].

2- Basra City and Climate

Basra governorate was selected as a study field. Geographically, the governorate is located in the southern part of Iraq in the northwestern corner of the Arabian Gulf, at longitude 46 ° 60 'to 48 ° 60' east and latitude 29 ° 13 'to 31 ° 29' N, the total area is 19,070 [7]. Basra has a hot desert climate, like the rest of the surrounding area, although it receives rainfall slightly than inland because of its location near the coast.

During the summer months, from June to August, Basra is consistently one of the most important cities on the planet, with temperatures regularly reaching 40°C and approaching 45 °C in July. In winter Basra is exposed to moderate weather with average temperatures about 20 °C. On some winter nights, the minimum temperatures are below 0 °C. High humidity sometimes exceeds 90% which is common due to proximity to the marshy Arabian Gulf [8, 9].

3- Data and Methods

The data used in the research was obtained from the Iraqi Meteorological Organization, and Seismology for both Al Hussein station and Basra Airport station for the period from 1990 to 2012. While Al Hussein station was considered an urban station depending on its location in the center of Basra. The Basra airport station was considered a desert station depending on its location in the northwest of the city of Basra [10]. The surface air temperature varied from place to place, obvious variance from of rural and urban areas and that the magnitudes of these differences can be quite large sometimes depending on weather conditions, urban thermo-physical and geometrical characteristics. To calculate this difference between urban and rural temperature, we used the following equation [6]:

$$\Delta T = T_U - T_D \quad (1)$$

Where:

ΔT = Difference in temperature °C

T_U = Urban temperature °C (Al-Basra Station)

T_D = Desert temperature °C (Airport Station)

4- Result and Discussion

The temperature variance was calculated for the months four January, April, July, and October which represent a year. Using equation (1), we calculate ΔT starting from 1990 to 2012.

The Variance of maximum temperature

The annual variation in the maximum temperature for January to both the urban station and Desert station as shown in figure (2). The small different was found (-0.3) °C in 2010, while large different found in 1991 was 1 °C. The average difference was 0.3 °C for the study period. The difference in

temperature was very low between the two stations (sometimes the temperature of the airport station is higher), despite that a large number of human activities and the widespread spread of pollutants in the city of Basra, the desert regions have clear impact to raise the temperature in neighboring areas. This is due to the nature of the desert land, which is characterized by its high ability to gain heat during the daytime.

The annual variation in the maximum temperature for April to both the Urban station and Desert station as shown in figure (3). The small different was (-1.8) °C in 2008, while large different in 1998 was (0.5) °C. The average difference was (-0.12) °C for the study period.

The annual variation in the maximum temperature for July to both the urban station and Desert station as shown in figure (4). The small different was (-3.2) °C in 1998, while large different in 2007 was 1.7 °C. The average difference was -0.14 °C for the study period.

During October, the annual variation of the minimum temperature to both two stations explains in figure (5). The low different was found (-0.5) °C in 1999, while large different found in 2011 was 1.6 °C. The average difference was 0.18 °C for the study period.

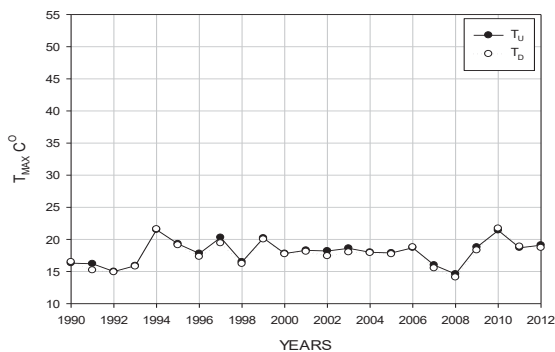


Fig.(2): The annual change of maximum temperature during January

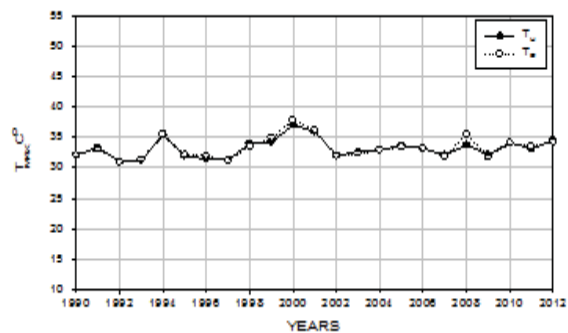


Fig.(3) The annual change of maximum temperature during April

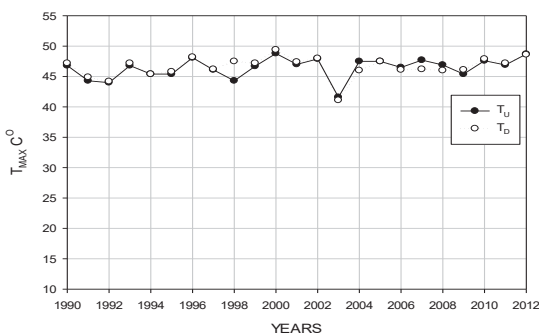


Fig.(4): The annual change of maximum temperature during July

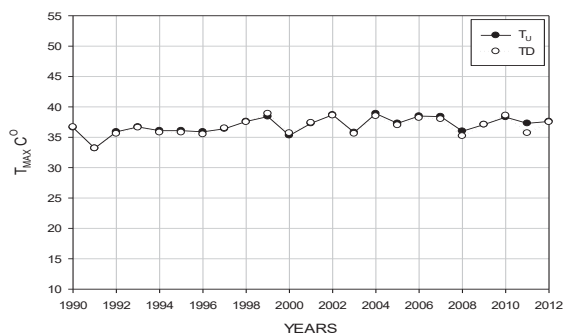


Fig.(5): The annual change of maximum temperature during October

The difference in the maximum temperature between the stations shown in Table (1) which shows that the largest difference was in January (although the average of differences did not exceed 0.3 °C in average). In April and July, the variance in the maximum temperature between the two stations was different as the temperature of the airport station was higher than the temperature of the Al-Hussein station for most years. Also, in October the difference was very small.

Table (1): The difference in the maximum temperatures ΔT_{U-D} .

Year	T _{max} °C January Δ	T _{max} °C April Δ	T _{max} °C July Δ	T _{max} °C October Δ
1990	-0.2	-0.1	-0.4	-0.1
1991	1	0.3	-0.6	0
1992	0.1	0	-0.2	0.3
1993	0.1	-0.1	-0.4	0.1
1994	-0.1	-0.2	0	0.3
1995	0.2	-0.2	-0.4	0.3
1996	0.5	-0.5	-0.1	0.4
1997	0.9	0.1	-0.1	-0.1
1998	0.3	0.5	-3.2	0.1
1999	0.2	-0.7	-0.5	-0.5
2000	0.1	-0.8	-0.6	-0.4
2001	0.2	-0.3	-0.4	-0.1
2002	0.8	0.1	-0.1	0.1
2003	0.6	0.2	0.5	0.2
2004	0.1	0	1.5	0.4
2005	0.2	0.2	0	0.3
2006	-0.1	-0.1	0.4	0.3
2007	0.5	0.3	1.5	0.4
2008	0.5	-1.8	0.9	0.8
2009	0.5	0.4	-0.7	0
2010	-0.3	0	-0.3	-0.3
2011	-0.2	-0.4	-0.3	1.6
2012	0.4	0.3	0.1	0.1
mean	0.3	-0.12	-0.14	0.18

The Variance of minimum temperature

The annual variation in the minimum temperature for January to both the Urban station and Desert station as shown in figure (6). The small different was found (-0.1) °C in 1999 (The temperature of the airport station is higher than the temperature of the Hussein station), while large different found in 2004 was 3 °C. Despite that the high variance value in 2004, the average difference was as low as 1.4 °C for the study period. The difference in the minimum temperature was greater than the difference in the maximum temperature. This is due to the rapid loss of heat in desert areas, and on

the other hand, cities retain large amounts of heat due to the nature of their components as well as increasing greenhouse gasses at night in cities and the tendency of wind to calm.

The annual variation in the minimum temperature for April to both the urban station and Desert station as shown in figure (7). The small different was found (0.6) °C in 2008, while large different found in 2001 was 3.2 °C. The average difference was 1.9 °C for the study period.

The annual variation in the minimum temperature for July to both the urban station and Desert station as shown in figure (8). The small different was found (0.8) °C in 1998, while large different found in 2010 was 5.5 °C. The average difference was 3.5 °C for the study period.

The annual variation in the minimum temperature for October to both the urban station and Desert station as shown in figure (9). The small different was found (1.7) °C in 2008, while large different found in 2011 was 5 °C. The average difference was 3.7 °C for the study period.

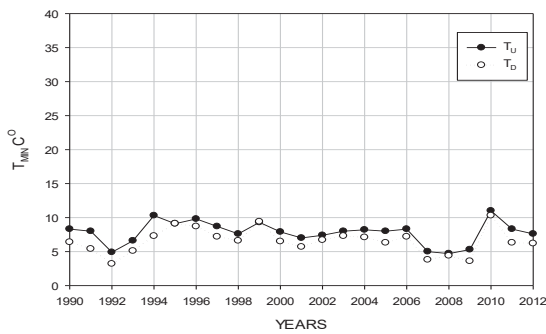


Fig.(6): The annual change of minimum temperature during January.

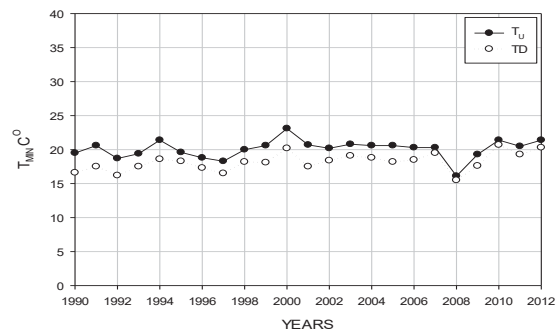


Fig.(7): The annual change of minimum temperature during April.

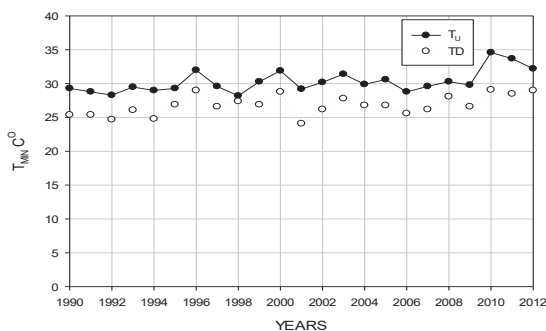


Fig.(8): The annual change of minimum temperature during July.

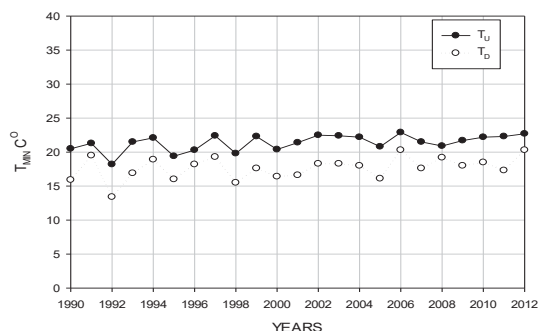


Fig.(9): The annual change of minimum temperature during October.

Table (2) shows the difference in the minimum temperature between Al Hussein station and the airport station for the years 1990 to 2012, where the difference was clear and large, especially in July and October.

Table (2): The difference in the minimum temperatures ΔT_{U-D} .

Year	ΔT_{\min} °C January	ΔT_{\min} °C April	ΔT_{\min} °C July	ΔT_{\min} °C October
1990	1.9	2.9	3.9	4.6
1991	2.6	3.1	3.4	1.8
1992	1.7	2.5	3.6	4.8
1993	1.5	1.9	3.4	4.6
1994	3	2.8	4.2	3.2
1995	0	1.3	2.4	3.4
1996	1.1	1.5	3	2.1
1997	1.5	1.8	3	3.1
1998	1	1.8	0.8	4.3
1999	-0.1	2.5	3.4	4.7
2000	1.4	2.9	3.1	4
2001	1.3	3.2	5.1	4.8
2002	0.7	1.8	4	4.2
2003	0.7	1.7	3.6	4.1
2004	1.1	1.8	3.1	4.2
2005	1.7	2.4	3.8	4.7
2006	1.1	1.8	3.2	2.6
2007	1.2	0.8	3.4	3.9
2008	0.3	0.6	2.2	1.7
2009	1.7	1.7	3.2	3.7
2010	0.7	0.7	5.5	3.7
2011	2	1.2	5.2	5
2012	1.4	1.1	3.2	2.4
mean	1.4	1.9	3.5	3.7

5- Conclusions

The effect of desert areas was evident at maximum temperatures as the difference between the city and the surrounding areas diminished. The maximum temperature of the airport station was higher than the temperature of the Hussein station in most years. The difference in the minimum temperature between the two stations was higher than the difference in the maximum temperature, where the difference in July was 3.5°C. In October, the difference was 3.7°C

6- Reference

- [1] Lin, X., and Hubbard, K. G. 2008: What are daily maximum and minimum temperatures in observed climatology? *Int. J. Climatol.* **Vol. 294**, P. 283–294.
- [2] Jabbar, M. T., and Jing-xuan Z., 2013: Environmental degradation assessment in arid areas: a case study from Basra Province, southern Iraq. *Environ Earth Sci.*, **Vol.70**, P. 2203–2214
- [3] Abu Amra, S.M., 2009: The heat island study in climate science. thesis submitted to Islamic University, college of Literature in Gaza, Palestine. P. 98.
- [4] Al-Lami, A. M., 2015: Study of Urban Heat Island Phenomena for Baghdad City using Landsat-7 ETM+ Data. *Diyali Journal for Pure Sciences.* **Vol. 11, No. 2**, p. 82 – 98.
- [5] United National (UN) 2001: World urbanization prospect. United Nations Population Division, Department of Economic and Social Affairs, United Nations Secretariat, New York, USA, pp. 34.
- [6] Oke, T. R., 1987: Boundary layer climates. 2nd ed. London, pp. 435.
- [7] Hadeel, A. S., Mushtak T. J., and Xiaoling C., 2010: Application of remote sensing and GIS in the study of environmental sensitivity to desertification: a case study in Basra Province, southern part of Iraq. *Appl Geomat*, **Vol. 2**, P.101–112
- [8] Al-musaed, A., and A. Almssad. Heat island effects upon the human life on the city of Basra. 2nd, PALENC conference 2007, **Vol. 1**, P. 45:47
- [9] Al-Hassen, S.I., Sultan, A.W.A., Ateek, A.A., Al-Saad, H.T., Mahdi, S. and Alhello, A.A., 2015: Spatial Analysis on the Concentrations of Air Pollutants in Basra Province (Southern Iraq). *Open Journal of Air Pollution*, **Vol. 4**, P. 139-148.
- [10] Ministry of Transport, the Iraqi Meteorological Organization, and Seismology, Climate Section, Climate Data for Baghdad Governorate, 1990- 2012, unpublished data.