Iraqi Journal of Science

Dust storm in Erbil city as a result of climatic change in Kurdistan Region Iraq

Qusai Y. Al-Kubaisi and Lookman M. M. Gardi
College of Science, University of Baghdad, Faculty of Engineering, Koya University

Abstract
Dust storm in Iraq is a climatic phenomenon. Dust storm data from 1992 to 2009 and data of main climatic parameters rainfall (1942 to 2010) and air temperature (1992 to 2009) of Erbil Meteorological Station were analysed. Results show an increase of the number of suspended and rising dust as well as dust storms with time. An average of the above mentioned period of all types of dust storms is individually compared with the last five years. Again, there is a noticeable increasing of the number of storms. From the results it can be seen that the months May, June, July and August have the most frequent dust conditions while months January, February, November and December the least. The annual precipitation trend line for water years has a significant decreasing slope. While the average annual air temperature trend line has a significant increase.

Key words: Dust storm, suspended dust, raised dust, climatic change and temporal variations.

العواصف الغبارية في مدينة اربيل كنتيجة للتغيرات المناخية في اقليم كوردستان – العراق

قصي ياسين الكبيسي[1] و لقمان مغديد محمد امين كاردي[2]
[1]كلية العلوم ، جامعة بغداد، [2]عمادة الهندسة ، جامعة كويا

الخلاصة
تعتبر العواصف الغبارية في العراق ظاهرة مناخية ، وقد تم تحليل القياسات المتوفرة عن العواصف الغبارية للفترة من ١٩٩٢ لغاية ٢٠٠٩ اضافة الى المعلومات المتوفرة عن الامطار (للفترة ١٩٤٢ – ٢٠١٠) والحرارة (للفترة ١٩٩٢–٢٠٠٩) لمحطة انواء اربيل
اظهرت النتائج زيادة الغبار العالق والمتصاعد اضافة الى العواصف الغبارية وخاصة في اشهر مايس وحزيران وتموز واب كما اظهرت قياسات معدلات الامطار السنوية بانخفاض كمياتها وزيادة بمعدلات درجة الحرارة السنوية

Introduction

A dust storm is a meteorological phenomenon common in arid and semi-arid regions. Dust storms arise when a gust front or other strong wind blows fine particles and loose sand from a dry surface. Erbil city in Kurdistan Region, like the rest of Iraq is suffering from the significant increase in dust storms. Dust storms occur because of the sharqi winds from the south and southeast and the shamal winds from the northwest.

Several dust storm studies were conducted in Iraq. The researchers were focused on the spatial distribution and the load analysis of the storms (1,2). This study analyses the dust storm trends in a single

Qusaikubs@yahoo.co.uk

meteorological station in time. Then, compare dust storm trend line with the most important climatic parameters namely air temperature and precipitation in the area.

The studied meteorological station lies at northeast of Erbil city (Figure 1). It has an altitude of 470 m a. s. l with longitude (44˚ 04´) and latitude (36˚ 12´). The area is a part of Erbil basin which is located between southern limb of Pirmam anticline and Dibaga hill zone. Geologically, it is part of the low folded belt of northern Iraq. The majority part of the area is covered by the Quaternary deposits, composed mainly of soils. The hill zones of the area consist of Bakhtiari formation of Pliocene age (2) .

The climate is characterized by dry and warm summers and cold winters. Precipitation occurs mainly in winter and spring, with minimal rainfall in summer. The average annual precipitation in the station is about 371 mm. Hydrogeologically, the area is bordered by the greater Zab and lesser Zab from NW and SE respectively,(3,4).

Dust storms in Erbil city have affected human life in many ways. It causes serious health problems. It also piles up quickly on everything in sight, and it can even have effect on day to day operations in all fields. The environmental and economic importance of the dust phenomenon emphasizes the need for a better understanding of its occurrence and of related climatic parameters in the region. The aim of this paper is to find out whether dust storms are increasing in time or not. Further, to determine its relationship with main climatic parameters. Although the source of dust storms is not entirely in Iraq, but still there are interrelation between these parameters.

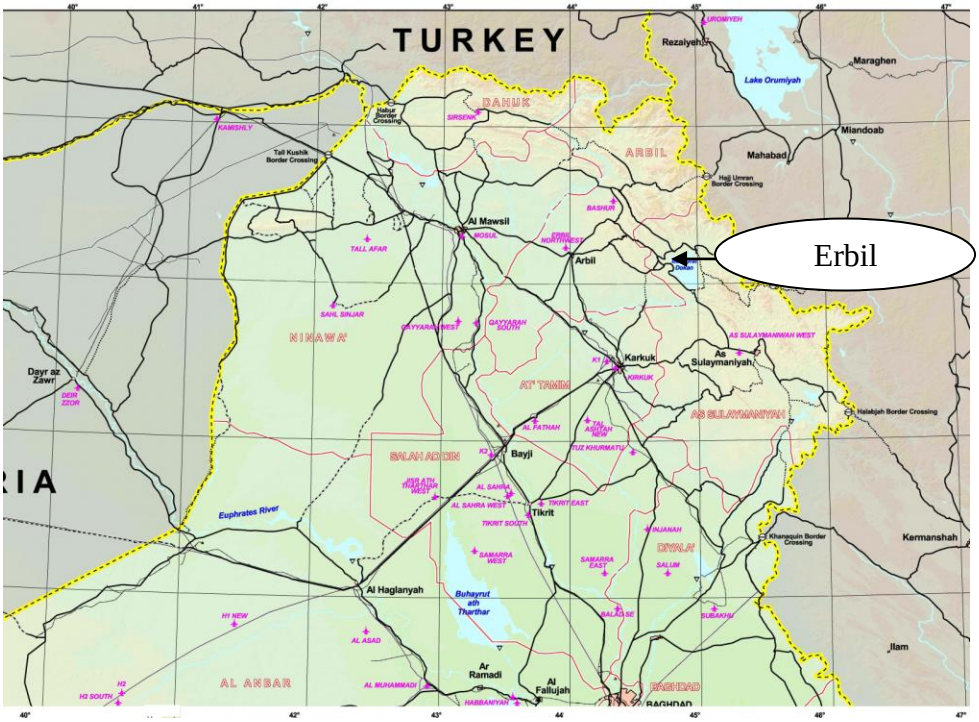

Figure 1- Map of North Iraq and Erbil Meteorological Station.

Methodology

To study the dust storm phenomenon in Erbil city temporally, the dust storm, air temperature and precipitation data were collected from Erbil Meteorological Station. Table 1- shows the period from 1992 -2009 and Number of dust storms, average annual air temperature in Celsius and total annual rainfall in mm.

Based on the density of dust particles, wind speed, and visibility, dust storms are classified into three types: suspended dust; consists of very fine and dry dust particles which reduces the visibility to 4 km and will remain in the air for long time, rising dust; occurs as a result of unstable weather condition due to the increase of air temperature in the region, the wind speed will be between 15-25 km/hr, the dust particles

will be risen to 15m or 1km in some places, and the visibility will be between 1-4km, and dust storms; this type of dust storm is a result of strong wind speed 37-60 km/s. The visibility is reduced to less than a 1km.

First, for determining the trend line of the above mentioned parameters, dust storm data from 1992 to 2009 and data of rainfall (1942 to 2010) and air temperature (1992 to 2009) of Erbil Meteorological Station have been plotted. Second a comparison between dust storms and the main climatic parameters was done. After that, number of dust storms for each five years period in each month is calculated and plotted in time.

Results and Discussion

Figure 2- shows the number of dust storms as dash line and number of other dust conditions (suspended, rising and dust storms) as solid line from January 1992 to December 2009 against time. Both trend lines show a clear increase of the number of dust storms in Erbil city.

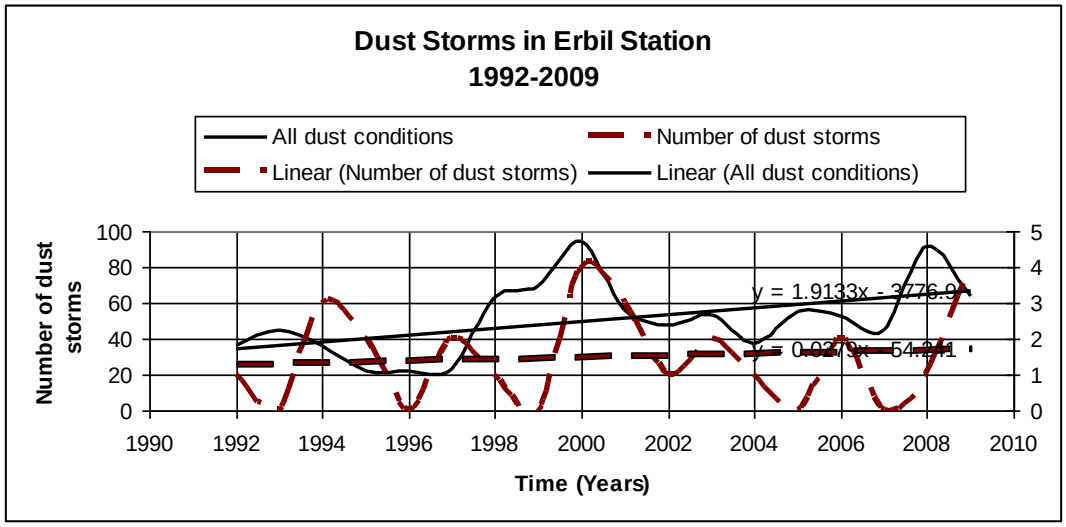

Figure 2- Dust storms – time relationship in Erbil.

The dust storm distribution throughout the year and detailed calculation for a period of 5 years are presented in table 1 and figure 3. From the results it can be seen that the months May, June, July and August have the most frequent dust conditions while months January, February, November and December the least. It is believed that this type of temporal distribution is related to other climatic parameters namely air temperature and precipitation.

Table 1- The dust situation in Erbil city from 1992 to 2009.

Months	Number of suspended, rising and dust storms				
	1992-96	1997-01	2002-06	2007-09	92-2009
January	1	2	3	1	7
February	1	7	6	13	27
March	9	12	15	18	54
April	18	29	26	16	89
May	42	42	37	25	146
June	29	46	30	33	138
July	14	58	31	24	127
August	16	42	34	29	121
September	13	36	20	18	87
October	9	22	32	13	76
November	6	12	8	4	30
December	2	2	3	6	13

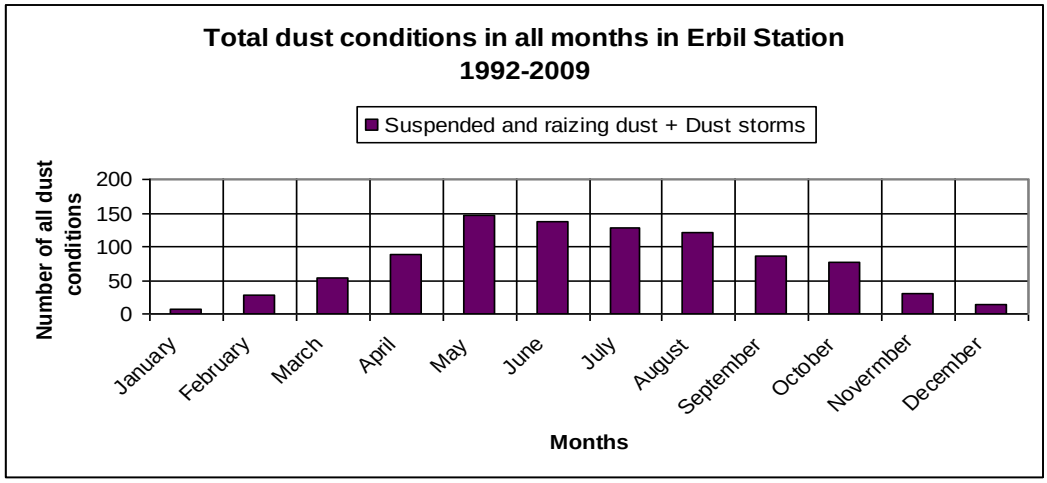

Figure 3- Distribution of dust storms throughout the year.

Figure 4 and 5 present the relationship between average annual air temperature and annual precipitation for the same time period. The trend of average air temperature increases while the one of rainfall is reduced. Air temperature is not only one of the main climatic parameter every where but also affects the other parameters such as humidity, wind speed and direction, precipitation and of course dust storms.

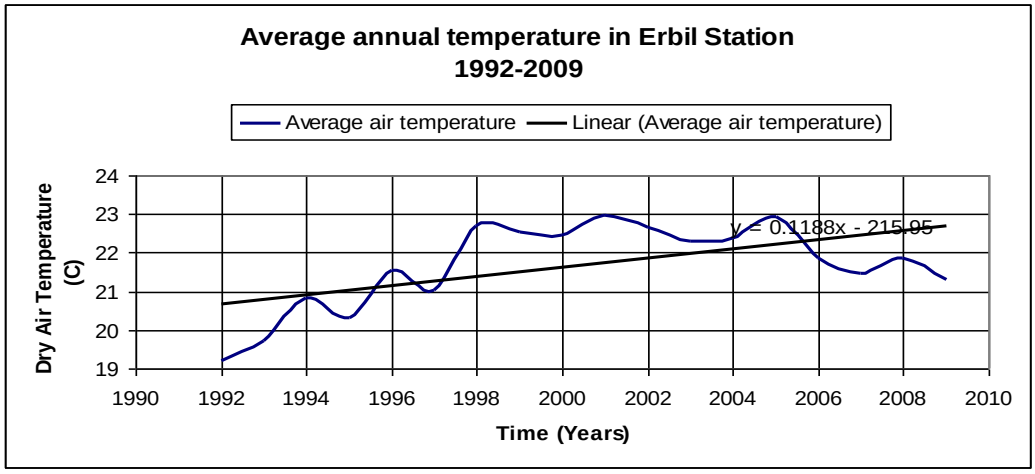

Figure 4- Average annual air temperature versus time.

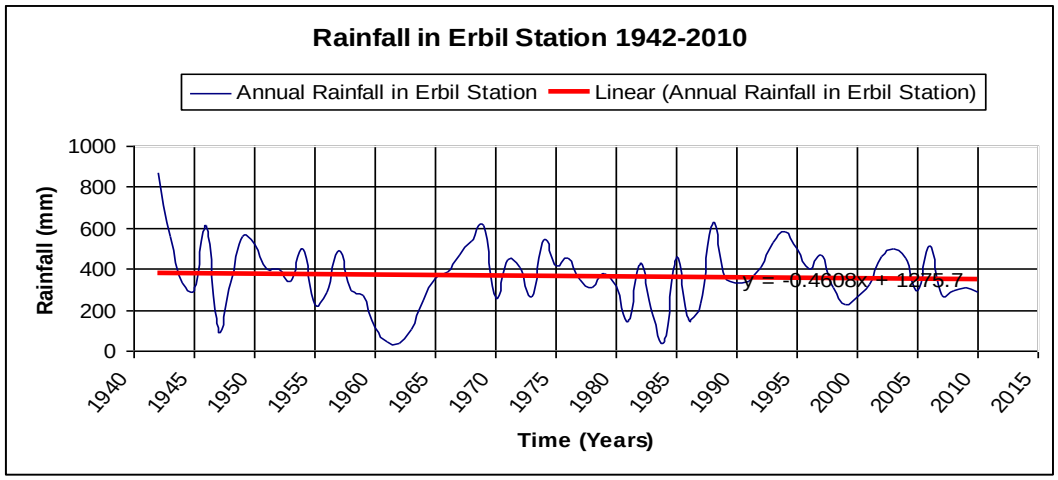

Figure 5- Annual rainfall in Erbil area.

The annual rainfall trend line for the period of 70 years has a significant decreasing slope. While the average annual air temperature trend line has a clear increase. To compare the dust situation with the above mentioned climatic parameters at the same station, five biggest dust situations (number of suspended, rising and dust storms) are chosen. Data in table 2 show an obvious relationship between number of dust storms and annual rainfall and average annual air temperature. The biggest number of dust storms is associated with the minimum amount of annual rainfall and the highest average annual air temperature. This is probably due to the regional climate change of the area.

Table 2- Five biggest dust storm years with other specifications.

Year	Number of all dust storms	Average annual air temperature (c°)	Annual rainfall (mm)
2000	94	22.47	268.5
2008	91	21.88	273.4
1999	70	22.51	229
2009	64	21.31	295.6
1998	63	22.70	310.3

Conclusions

From data analysis of dust storms in Erbil meteorological station was seen that the number of dust storms is increasing in time. This increase includes dust storms and suspended and rising dusts. Other results presented in this paper show dust storm distribution throughout the year and it can be seen that the months May, June, July and August have the most frequent dust conditions while months January, February, November and December the least. It is believed that this type of temporal distribution is related to other climatic parameters namely air temperature and precipitation.

The trend of average air temperature in time increases while the one of rainfall is reduced. There is a strong relationship between number of dust storms and annual rainfall and average annual air temperature. The biggest number of dust storms is associated with the minimum amount of annual rainfall and the highest average annual air temperature. This is probably due to the regional climate change of the area.

Acknowledgements

The authors are grateful to Mr. Rashid Rasoul former director of Directorate of Meteorology & Seismology in Erbil for providing all the data. Both Mr. Talaat Sabir and Abdulmutalib Tahir from the same directorate are thanked for assistance and discussion on types of dust storms.

References

1. Al-Dabbas M, Abbas M, Al-Khafaji R (**2010**) Dust storms loads analyses -- Iraq, Arab Journal of Geosience, N0. 5 p. 121-131 (2012).
2. Sharif Azad Jalal (**1998**) Erbil area climate comparative study on local climate, Ph.D. thesis, College of Arts , University of Salahaddin Erbil.
3. UNESCO/WMO. (**1985**). Hydrological Aspects of Drought. Prospects for the limitation of the consequences of hydrological drought. 141-146.
4. Zand Rashid Rasoul (**2001**) Weather and local climate of Erbil city in 1999, Report for Agricultural Meteorology Department of FAO-Iraq.