Online Journal of Earth Sciences

MEDWELL PUBLICATIONS SINCE 2000

# Relationship Between Air Elements, Dust Phenomenon and Wind Erosion for Two Stations at Wasit Province for the Period 1994-2016

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**Key words:** Climate factors, dust storms, lower dust, rising dust, happening

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Page No.: 1-16
Volume: 14, Issue 1, 2020
ISSN: 1991-7708
Online Journal of Earth Sciences


**Abstract:** The study underwent for two selected stations at Wasit province (Al-Azizyah, Al-Hay). The study relied on the climate data that issued from the general committee of Iraqi Meteorological and Seismic Monitoring for the period 1994-2016. The relationship of Air Elements were studied with the (temperature, wind speed, rain quantity and humidity) with dust phenomenon that represented by dust storms, lower dust and rising dust. The correlation was analyzed to know the effect of these elements on the happening of the dust storms and it was clear that the relationship between the climate's two elements (temperature and wind speed) and the dust phenomena (Dust storms, lower storm, rising dust) is an extreme relationship and the relationship between the climate elements (rain and humidity) and the dust phenomenon (dust storms, lower dust, rising dust) is a reverse relationship. Also by counting the general trend of the dust storm of the two studied stations, the results showed that the general trend of the dust storm toward an increase.

## INTRODUCTION

The dust phenomenon means the rising of dust and sand particles and other planktons on the surface of the ground and spreading in the air causing reduction in air transparency and range of visibility which lead to surface air pollution, dimness, feeling tight and discomfort .Instead of all that, it effects on human health, vitality ,growth and production of livestock. The dust phenomenon is known aerodynamically as clay particles, silt and sand ranging between 1yakteen-500 μ and their shapes ranged between sheet forms and irregular forms for the clay's particles and silt while it takes oval and circular forms for the sand's particles[1]. Dust phenomena can be divided based on their diameters and wind speed and sight range to:

**Dust and sand storms:** The dust storm is consisted of if the speed wind doesn't increase to make the dusty storm which is about 5.5 m $sec^{-1}$, the storm rises the dust for many kilometers and the visibility will decrease less 1 km and sometimes to 100 m at the intensive dust storms. The particles diameter reached in these dust storms to about 100 μ[2].

Sand storms usually are local if we compare them with sand storms which are local or regional. The formulation of the sand storms are similar to the formulation of dusty storms, but their resources come from the desert regions that have sand dunes and consisted of sand atoms that ranged between 80 μ-1 mm with close heights of the ground surface and localized at the near regions that near to the Western hill specially, the regions that rich with sand dunes that never mixed with soil atoms.

The soft silt atoms, mud and sand that transferred by dusty storms almost covered a widely areas due to the their small sizes if we compare to the sand atoms in case of sandy storms[3].

The sand storm phenomenon at specific area submitted to a physical and complicated factors starting with the nature of the soil in the area and surrounded area passing with human's different activities and ending with combined weather factors[4].

**Rising dust:** This phenomenon happens due to the air instability resulted from the intensive heating for the surface of ground with many changes in the air pressure slope that lead to form air vortex that rise the dusty particles to 150 m height[5]. The speed of wind a mostly is moderate or relatively few ranged between 15-25 km $h^{-1}$. Based on the Purfort scale in the fourth place the sight is ranged between 1-5 km. The particles of dust never move to a far distance just in case of a very intensive instability and after rising to the highest level in the air it start going down and precipitation and also could be seen suspended in the air and lead to reduction in sight vertically and horizontally for distances close to 100 m or less in the extreme conditions that cause serious risks on navigation system[3]. As well as its effect when it deposited on crop leaves and accompanied with damages that effect the food making process.

**Suspended dust:** This kind of air phenomenon is formed after the occurrence of dust storm or the rising dust phenomenon as the dust particles suspended in the air from several hours to several days and the range of visibility between 1-5 km and the wind speed is <3.6 sec $m^{-1}$ and the diameters of dust particles is <1 μ and sometimes the range of visibility reduce to <1 km, especially after the occurrence of intensive dusty storms and this status is called the intensive suspended dust[6]. The suspended dust may related to the existent of dusty storm in other place transferred by active winds for long distance of emergence source and when the storm was far from the pressure gradient the speed will be less including the dust atoms that are small in size and low in weight[7] because some of them formed mainly from mud and silt of very small diameters[3].

These low speeds of winds or the serenity are able to carry them and keep them in the air for periods from 1-5 h[7]. In order to distinguish between the dust storm and other dust phenomena, the range of visibility is the definitive factor between risen dust and the suspended dust (Table 1).

Table 1: The types of the suspended dust based on the particles diameters wind speed and vertical visibility

| Type of dust | Particles diameters (μ) | Winds speed (m $sec^{-1}$) | Vertical visibility range (km) |
|---|---|---|---|
| Suspended dust | <1 μ | Less (3.6 m $sec^{-1}$) | (1-5) |
| Rising dust | 1-10 μ | (15-25 km $h^{-1}$) | (1-5) |
| Dust storm | Not >100 μ | (5.5 sec and more) | (<1) |
| Sand storm | Between 80 μ-1 mm | (8 m $sec^{-1}$ and more) | (<1) |

Table 2: Names of study's stations, numbers and heights on the level of sea and geographic location

| Station | Station number | Wide latitude (North) | Longitude (East) | Height of station $m^{-1}$ |
|---|---|---|---|---|
| Al-Azizyah | 660 | 32.91 | 45.06 | 18 |
| Al-Hay | 665 | 32.17 | 46.05 | 17 |

The work of researcher depends on the climate's data issued from the general committee of Iraq Metrological and Seismic monitoring

**Research problem:** This study highlights on the relationship between the climate factors and the repeating of the dust phenomena at Wasit province, so, we can determine the problem of this study by the following question: (Is there a relationship between the climate factors with the repeating of dusty phenomena at Wasit province).

**Research hypothesis:** Hypothesis of the research was determined. So, there is a relationship between the climate factors and the repeating of the dust phenomena at Wasit province.

**The goal of the research:** The research aims to study the changes that happen to the climate factors represented by temperature, wind speed, rain's quantity and humidity for the period between 1994-2016 and the change that arise on the dusty phenomena represented by dusty storms, suspended dust and the risen dust to whether the relationship between them is negative or positive and knowing the general trend for these phenomena are they increasing or decreasing.

**Boundaries of studied area:** The study's area is determined at Wasit that is located in the middle of Iraq. Babylon and Al-Qadisiyah are adhering Wasit province from West and Mehran that belongs to Iran is adhering Wasit from east. Two stations in Wasit were selected, Al-Azizyah that is in North of Wasit and Al-Hay station that is located in the South of Wasit province based on Table 2. The time limits was for the period from 1994-2016.

## PRACTICAL PART

The study was conducted on two selected stations at Wasit province (Al-Azizyah, Al-Hay). The climate data

Fig. 1: Distributing of these climate stations of the study on the map; Depending on the topographic Iraq maps, 1996, measure1:1000000 by using GIS:10

issued from Iraqi general committee of meteorological and seismic monitoring for the period 1994-2016, throught that we can identify the range of influence of selected climate factors represented by temperature, wind's speed, rain's quantity and moisture rate in repeating the dusty phenomena that represented by dusty storms, suspended and rising dust. Also, analyzing correlation that known as statistical mean depends on the relationship between two variables each one represents a specific phenomenon whereas if one of them changed in a certain trend (increase or decrease) and the other changed in the same trend, the correlation will be positive or trivial. But if the change happened in the opposite direction (increase in one variable with increase in the other variables) the correlation will be negative or inversely[8] between these elements and the number of dusty phenomena days (Fig. 1).

Hereunder, we will discuss the relationship between the climate elements (temperature, winds, rains, humidity) and the dust phenomena (dust storm, rising dust, suspended dust) depending on the data issued from Iraqi general committee of Metrological and seismic monitor for the two stations at Wasit province (Al-Azizyah and Al-Hay) for the period from 1994-2016.

## TEMPERATURE

Temperature is considered one of the main climate's elements in terms of its direct influence in barometric pressure and therefore on the winds speed and forming clouds and rainfall and evaporation rates[9].

The number of dust phenomena days is different based on the months of the year through Table 3-9 and through the Fig. 2 and 3 we notice increase in the days number of hot months and decrease in the total of days of cold months as following:

**Al-Azizyah's station:** The monthly averages of temperatures of the period from 1994-2016 had recorded a highest temperature in July whereas reached to 36.5 and the days of dust storms were 10 days, the suspended dust were 360 days and the rising dust reached to 380 days. The lowest value for temperature that has recorded in January is 10.9 and the total of dusty storms is 0, the suspended dust is 43 and the rising dust is 33.

**Al-Hay's station:** It had recorded a highest temperature in July whereas reached to 38 and the days of dust

Table 3: Monthly and annual averages Air temperature (Celsius) at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.2 | 12.3 | 17.2 | 25.8 | 31.8 | 36.1 | 36.5 | 34.4 | 30.1 | 23.7 | 17.9 | 13.4 | 10.9 | Al-Azizyah |
| 25.8 | 13.3 | 18.9 | 28.1 | 33.6 | 37.7 | 38 | 36.2 | 32 | 25.4 | 19.4 | 14.7 | 11.9 | Al-Hay |

Table 4: Monthly and annual averages for winds speed (m $sec^{-1}$) at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.7 | 3 | 2.8 | 3.1 | 3.5 | 4.3 | 5.1 | 5 | 3.7 | 3.7 | 3.8 | 3.4 | 3.2 | Al-Azizyah |
| 3.7 | 2.8 | 2.9 | 3.1 | 3.8 | 4.4 | 4.8 | 4.9 | 3.6 | 3.6 | 3.5 | 3.4 | 3 | Al-Hay |

Table 5: Monthly and annual averages for rains quantity (mm) at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.4 | 17.8 | 23.9 | 9.8 | 0.1 | 0 | 0 | 0 | 4 | 13.2 | 15.9 | 12.7 | 27.7 | Al-Azizyah |
| 10.9 | 20.6 | 23.7 | 4.9 | 0.2 | 0 | 0.3 | 0.1 | 5.6 | 13.1 | 19.4 | 14.8 | 28.3 | Al-Hay |

Table 6: Monthly and annual averages for humidity (%) at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | 70 | 60 | 44 | 33 | 28 | 27 | 28 | 34 | 47 | 54 | 63 | 73 | Al-Azizyah |
| 43.3 | 65.7 | 55.2 | 37.8 | 28.1 | 24.8 | 23.5 | 25 | 33 | 44.4 | 52.3 | 60 | 69.7 | Al-Hay |

Table 7: Total of Monthly and annual dust storm days at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74 | 0 | 0 | 5 | 1 | 2 | 10 | 11 | 19 | 16 | 8 | 2 | 0 | Al-Azizyah |
| 40 | 0 | 1 | 0 | 1 | 5 | 5 | 7 | 9 | 5 | 5 | 2 | 0 | Al-Hay |

Table 8: Total of Monthly and annual for the suspended dust at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2487 | 48 | 71 | 222 | 235 | 257 | 360 | 330 | 344 | 260 | 201 | 116 | 43 | Al-Azizyah |
| 2000 | 25 | 26 | 127 | 172 | 218 | 279 | 293 | 289 | 230 | 176 | 736 | 29 | Al-Hay |

Table 9: Total of Monthly and annual for the rising dust at study's stations for the period 1994-2016

| Average | Dec. | Nov. | Oct. | Sep. | Aug. | Jul. | June | May | April | March | Feb. | Jan. | Months stations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1932 | 36 | 32 | 91 | 165 | 262 | 380 | 315 | 200 | 172 | 160 | 86 | 33 | Al-Azizyah |
| 1533 | 22 | 36 | 69 | 127 | 204 | 281 | 238 | 153 | 142 | 132 | 93 | 36 | Al-Hay |

The work of researcher depends on the climate's data issued from the general committee of Iraq Metrological and Seismic monitoring

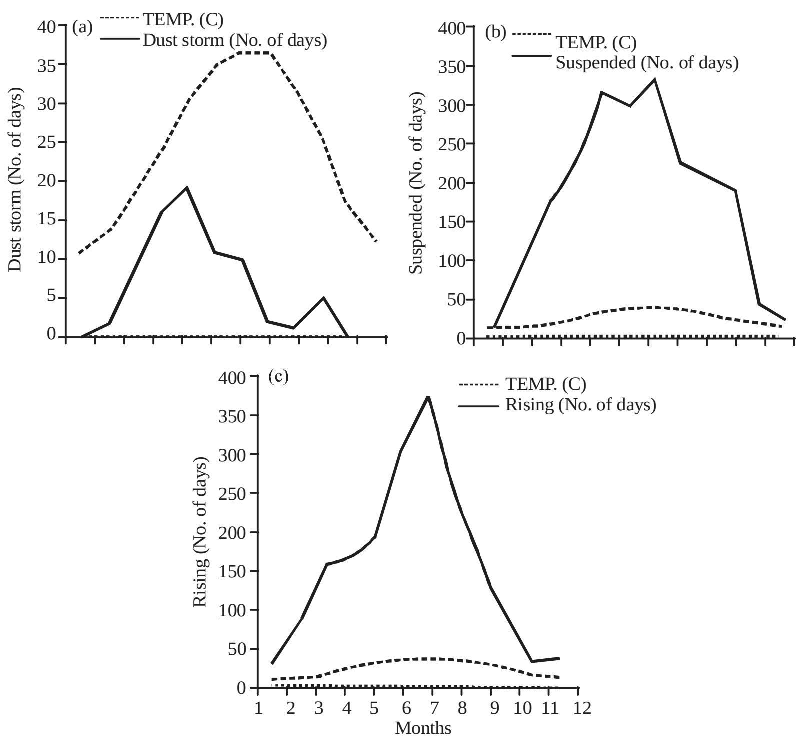


Fig. 2(a-c): The monthly averages of temperatures with dust phenomena for the period 1994-2016 of Al-Azizyah station

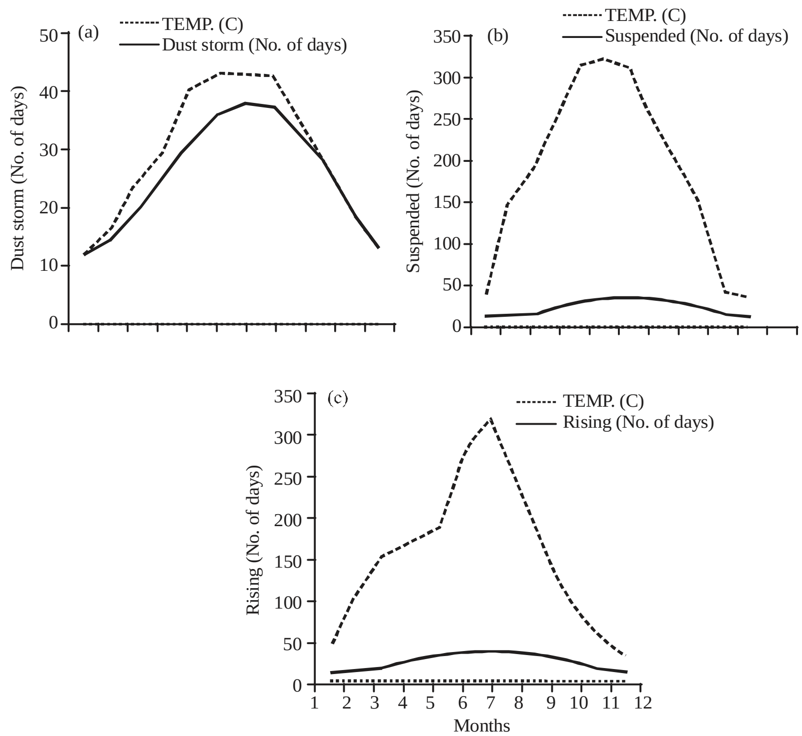


Fig. 3(a-c): The monthly averages of temperatures with dusty phenomena for the period 1994-2016 of Al-Hay station

Table 10: Correlation coefficient values between the total of months for dust storms days and monthly average at the study's stations for the period 1994-2016

| Station | Dust phenomena | Monthly correlation coefficient values | Type of correlation |
|---|---|---|---|
| Al-Azizyah | Dusty storms | 0.4 | Trivial correlation |
| | Suspended dust | 0.9 | Trivial correlation |
| | Rising dust | 0.9 | Trivial correlation |
| Al-Hay | Dusty storms | 0.6 | Trivial correlation |
| | Suspended dust | 0.8 | Trivial correlation |
| | Rising dust | 0.8 | Trivial correlation |

storms were 5 days, the suspended dust were 279 day and the rising dust reached to 281 days. The lowest value for temperature that has recorded in January is 11.9 and the total of dusty storms is 0, the suspended dust is 29 and the rising dust is 36.

**Monthly correlation of dust phenomena with temperature:** Table 10 shows coefficients values of monthly correlation between the months total of dust storms days number of temperature at study's stations during the period 1994-2016. It was noted that the monthly coefficient of correlation between monthly total of dusty storms days and the monthly average of temperature indicated for trivial correlative relationship at the two study's stations.

## WINDS SPEED

Winds are a moving air caused by the difference in atmospheric pressure values wheras it moves from the high pressure areas to the low pressure areas horizontally and parallel to the ground surface[10].

The winds considered a mechanical mean works to transfer the temperature energy, water vapor and results of the air phenomena between different areas[11].

Winds help in forming the dusty storms. Speed plays a great role in forming these storms because it is the influential factor to move these soil particles and transferring them to another locations.

The number of dusty phenomena days is different based on the months of the year through Table 4-9 and through, Fig. 4 and 5 we notice increase in the days number of hot months and decrease in the total of days of cold months as following:

**Al-Azizyah's station:** Monthly averages of temperatures of the period from 1994-2016 had recorded a highest temperature in July whereas reached to 5.1 m sec$^{-1}$ and the days of dusty storms were 10 days, the suspended dust were 360 day and the rising dust reached to 380 days. The lower value for temperature that has recorded in January is 2.8 m sec$^{-1}$ and the total of dusty storms is 0, the suspended dust is 71 and the rising dust is 32.

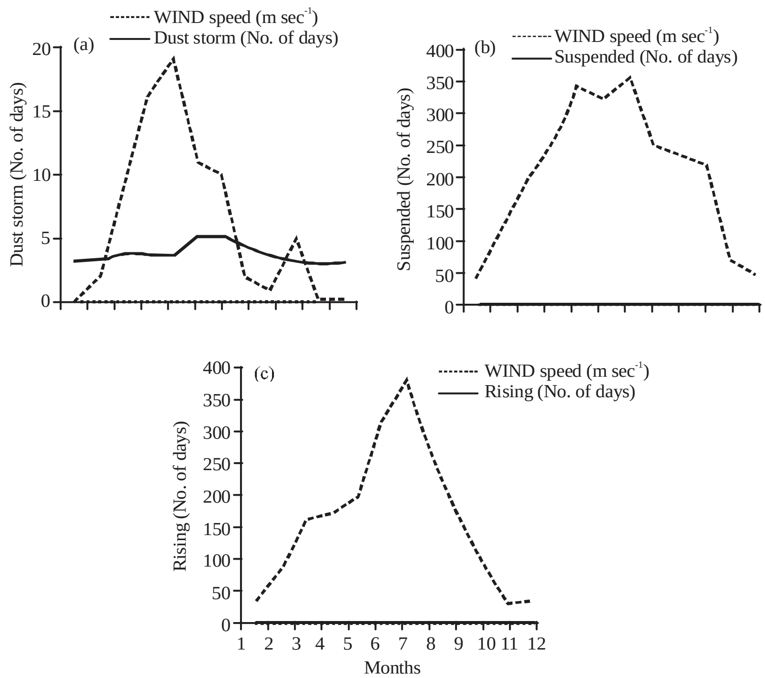


Fig. 4(a-c): The monthly averages of winds speeds with dust phenomena for the period 1994-2016 of Al-Azizyah's station

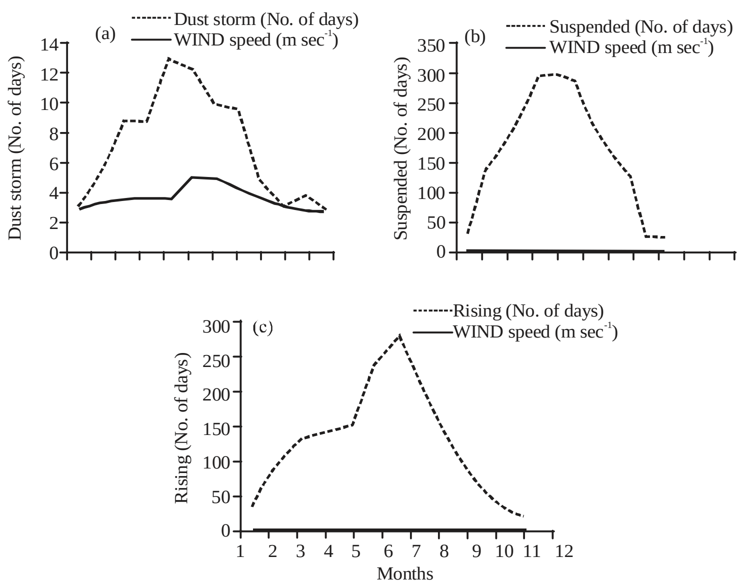


Fig. 5(a-c): The monthly averages of winds speeds with dust phenomena for the period 1994-2016 of Al-Hay's station

**Al-Hay's station:** It had recorded a highest temperature in June, whereas reached to 4.9 m sec$^{-1}$ and the days of dusty storms were 7 days, the suspended dust were 239 day and the rising dust reached to 238 days. The lower value for temperature that has recorded in December is 2.8 m sec$^{-1}$ and the total of dusty storms is 0, the suspended dust is 25 and the rising dust is 22.

**Monthly correlation of dusty phenomena with winds speed:** Table 11 shows coefficients values of monthly correlation between the months total of dusty storms days number of winds speed at study's stations during the period 1994-2016. It was noted that the monthly coefficient of correlation between monthly total of dusty storms days and the

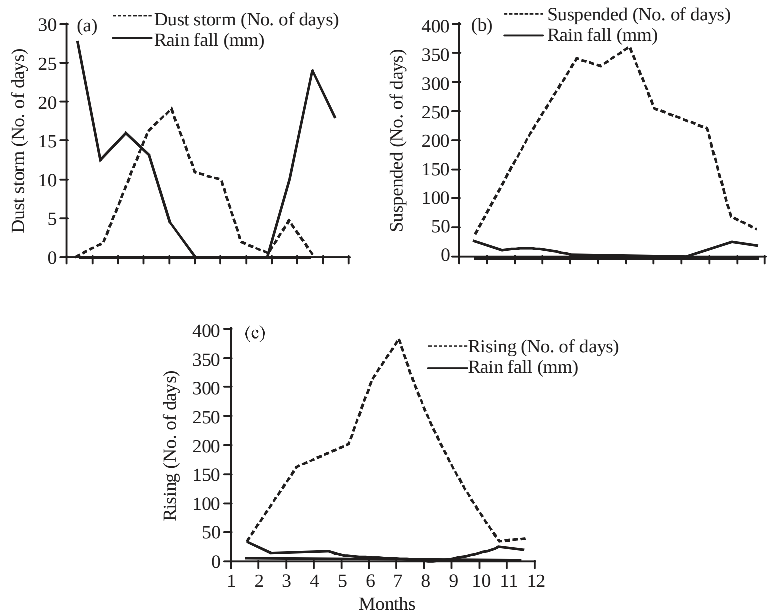


Fig. 6(a-c): The monthly averages of rains quantity with dust phenomena for the period 1994-2016 of Al-Azizya's station

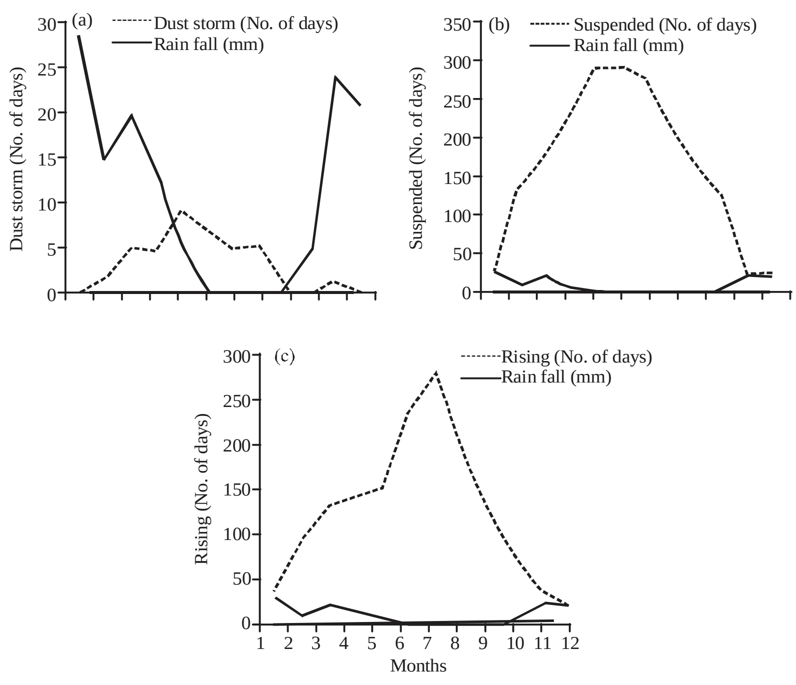


Fig. 7(a-c): The monthly averages of rains quantity with dust phenomena for the period 1994-2016 of Al-Hay's station

monthly average of temperature indicated for trivial correlative relationship at the two study's stations.

**Rains quantity:** Rain is considered one of the forms of falling and it is a water drops formed due to the water vapor condensation at the atmospheric air. The diameters of the drops are between 0.5-8 mm and the big drops splitting to many small drops[12]. Rain is considered one of the influential climate's factors to eliminate and reduce the impact of dusty storms. The rains that fall in Iraq characterized as being relatively little and non in some months. Generally, the total annual rains decreases from North to the South and from East to the West[16]. Through Table 5-9 and through, Fig. 6 and 7, we

Table 11: Correlation coefficient values between the total of months for dust storms days and monthly average at the study's stations for the period 1994-2016

| Station | Dust phenomena | Monthly correlation coefficient values | Type of correlation |
|---|---|---|---|
| Al-Azizyah | Dust storms | 0.5 | Trivial correlation |
| | Suspended dust | 0.8 | Trivial correlation |
| | Rising dust | 1.0 | Trivial correlation |
| Al-Hay | Dust storms | 0.7 | Trivial correlation |
| | Suspended dust | 0.8 | Trivial correlation |
| | Rising dust | 1.0 | Trivial correlation |

Table 12: Correlation coefficient values between the total of months for dusty storms days and monthly average at the study's stations for the period 1994-2016

| Station | Dust phenomena | Monthly correlation coefficient values | Type of correlation |
|---|---|---|---|
| Al-Azizyah | Dusty storms | -0.4 | Trivial correlation |
| | Suspended dust | -0.9 | Trivial correlation |
| | Rising dust | -0.8 | Trivial correlation |
| Al-Hay | Dusty storms | -0.5 | Trivial correlation |
| | Suspended dust | -0.8 | Trivial correlation |
| | Rising dust | -0.8 | Trivial correlation |

notice increase in the days number of hot months (little rain) and decrease in the total of days of cold months as (rainy months) following:

**Al-Azizyah's station:** The monthly averages of winds speed of the period from 1994-2016 had recorded a highest value of rains in January, whereas reached to 27.7 mm and the days of dusty storms were 0 days the suspended dust were 43 day and the rising dust reached to 33 days. The lower value for rain's quantity that has recorded in (June, July and August is) 0.0 mm and the total of dusty storms is 2, 10, 11, the suspended dust is 257, 360, 330 and the rising dust is 262, 380, 315.

**Al-Hay's station:** It had recorded a highest quantity of rains in June, whereas reached to 28.3 m $sec^{-1}$, days of dust storms were 0 days, the suspended dust were 29 day and the rising dust reached to 36 days. The lower value for quantity of rains that has recorded in August is 0, the total of dust storms is 5, the suspended dust is 218 and the rising dust is 204.

**Monthly correlation of dusty phenomena with rains quantity:** Table 12 shows coefficients values of monthly correlation between the total of months of dust storms days of rains quantity at study's stations during the period 1994-2016. It was noted that the monthly coefficient of correlation between monthly total of dust storms days and the monthly average of rains quantity indicated inverse relationship at the two study's stations.

Table 13: Correlation coefficient values between months total of dust storms days and monthly average of humidity at the study's stations for the period 1994-2016

| Station | Dust phenomena | Monthly correlation coefficient values | Type of correlation |
|---|---|---|---|
| Al-Azizyah | Dust storms | 0.5- | Trivial correlation |
| | Suspended dust | 0.9- | Trivial correlation |
| | Rising dust | 0.9- | Trivial correlation |
| Al-Hay | Dust storms | 0.6- | Trivial correlation |
| | Suspended dust | 0.8- | Trivial correlation |
| | Rising dust | 0.8- | Trivial correlation |

## HUMIDITY

The relative moisture means the percentage for what is existent really of water vapor in the air to a much more of humidity quantity that air can carry it in the same temperature and atmospheric pressure[14].

The days of dusty storms are different based on the months of the year through Table 6-9 and through the Fig. 9 and 8, we notice increase in the days number of hot months (dry) and decrease in the total of days of cold months (humidity) as following.

**Al-Azizyah's station:** The monthly averages of humidity for the period from 1994-2016 had recorded a highest value of humidity in December whereas reached to 73% and the days of dust storms were 0 days, the suspended dust were 43 day and the rising dust reached to 33 days. The lower value for rain's quantity that has recorded in July is 27% and the total of dusty storms days is 10 ,the suspended dust is 360 and the rising dust is 380.

**Al-Hay's station:** It had recorded a highest quantity of relative moisture in January, whereas reached to 69.7%, days of dusty storms were 0 days, the suspended dust were 29 day and the rising dust reached to 36 days. The lower value for quantity of rains that has recorded in August is 23.5% the total of dust storms days is 5 the suspended dust is 281 and the rising dust is 279.

**Monthly correlation of dust phenomena with humidity:** Table 13 shows coefficients values of monthly correlation between months total of dust storms days of humidity at study's stations during the period 1994-2016. It was noted that the monthly coefficient of correlation between monthly total of dusty storms days and the monthly average of relatively moisture indicated inverse relationship at the two study's stations.

**General trend of repeating dust phenomena**

**Dust storms; Al-Azizyah station:** Through Fig. 10 that includes annual total of repeated days of the dust storms of Al-Azizyah's station it has registered in the first decade of the period of study 1994-2004 the total of repeated days of dust storm was 5 day while in the second decade

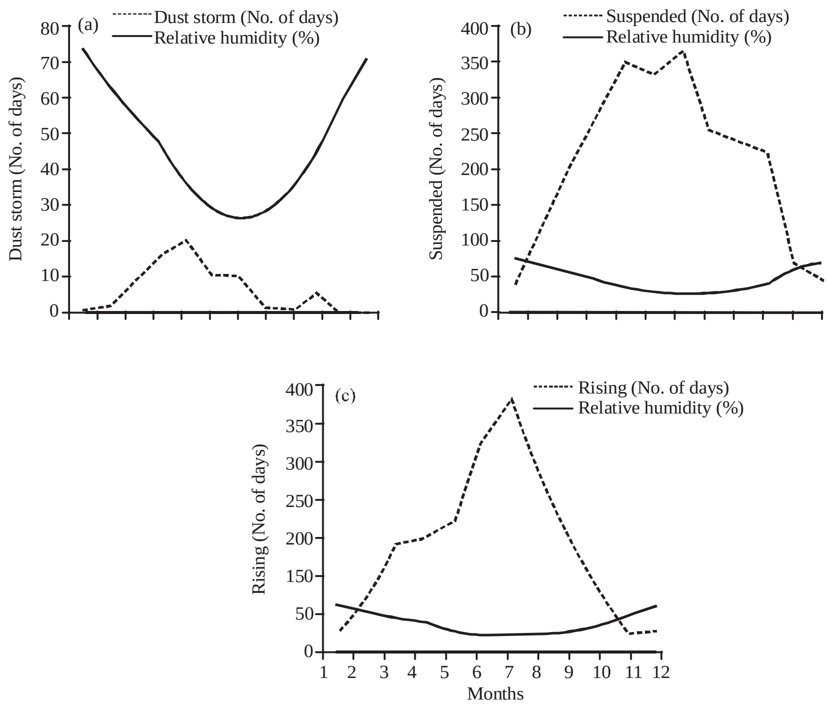


Fig. 8(a-c): The monthly averages of relatively moisture with dust phenomena for the period 1994-2016 of Al-Azizyha's station

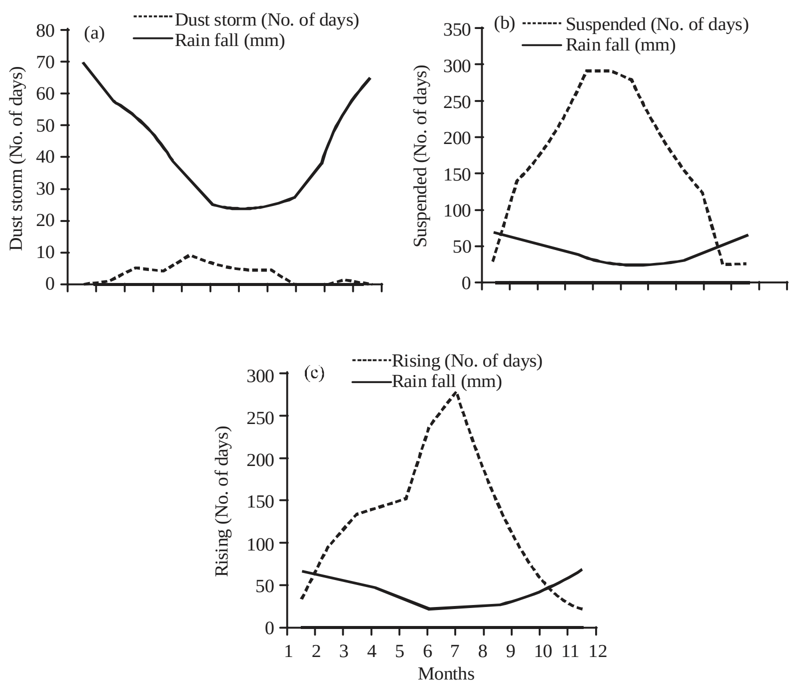


Fig. 9(a-c): The monthly averages of humidity with dust phenomena for the period 1994-2016 of Al-Hay's station

of the period of study 2004-2016 the total of repeated days of dust storm was 17 days. The general trend of the total of repeated dust storms days for the period 1994-2016 was up.

**Al-Hay's station:** Through Fig. 11 that includes annual total of repeated the days of dust storms of Al-Hay's station, it has registered in the first decade of the period of study 1994-2004 the total of repeated days of dust storm

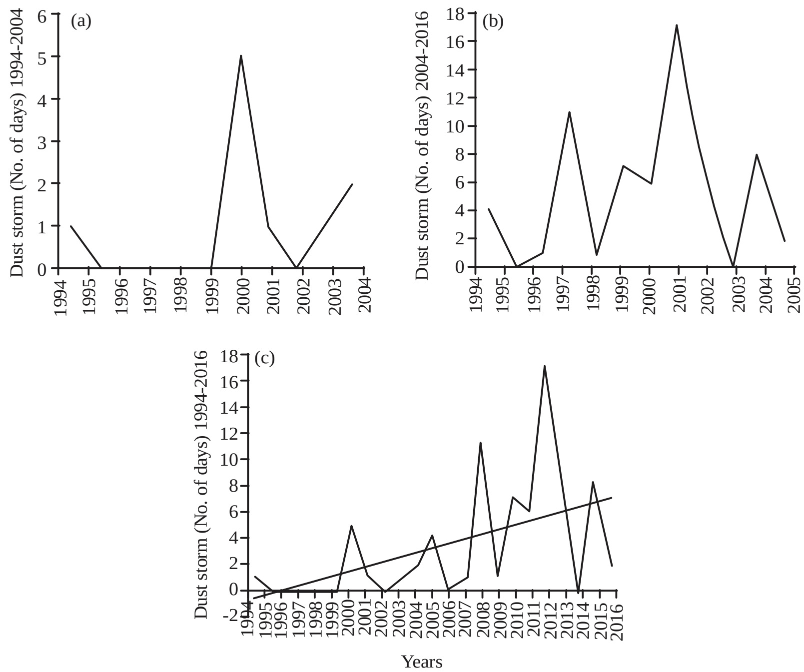


Fig. 10(a-c): Annoual total of repeated days of dust storms of Al-Azizyah's station

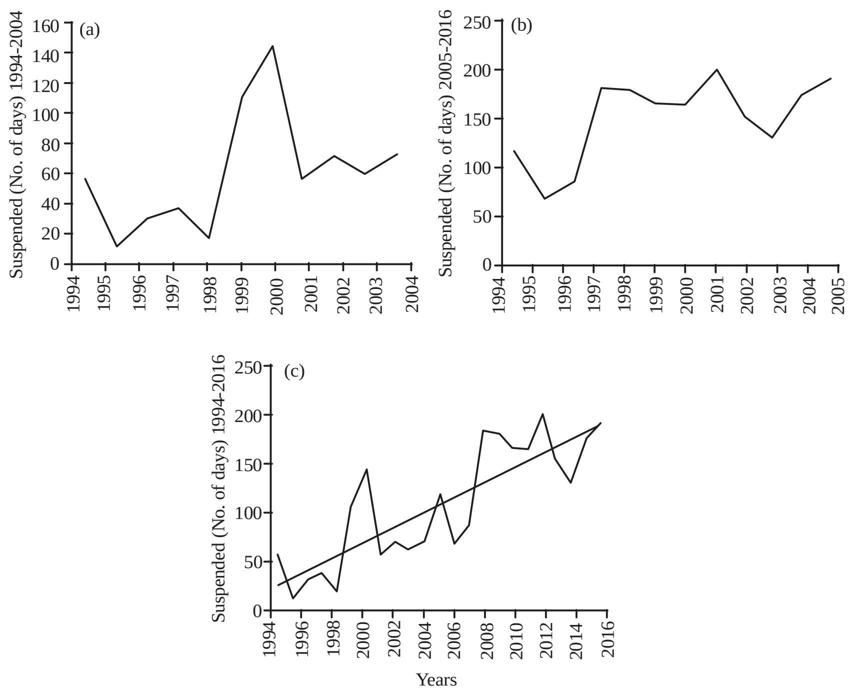


Fig. 11(a-c): The annual total of repeated days of dust storm of Al-Azizyah's station

was 4 day while in the second decade of the period of study 2004-2016 the total of repeated days of dust storm was 6 days. The general trend of the total of repeated dusty storms days for the period 1994-2016 was up.

**Suspended dust; Al-Azizyah station:** Through, Fig. 12 that includes annual total of repeated days of suspended dust of Al-Azizyah's station it has registered in the first decade of the period of study 1994-2004 the total of repeated days of suspended dust was 143 days while in

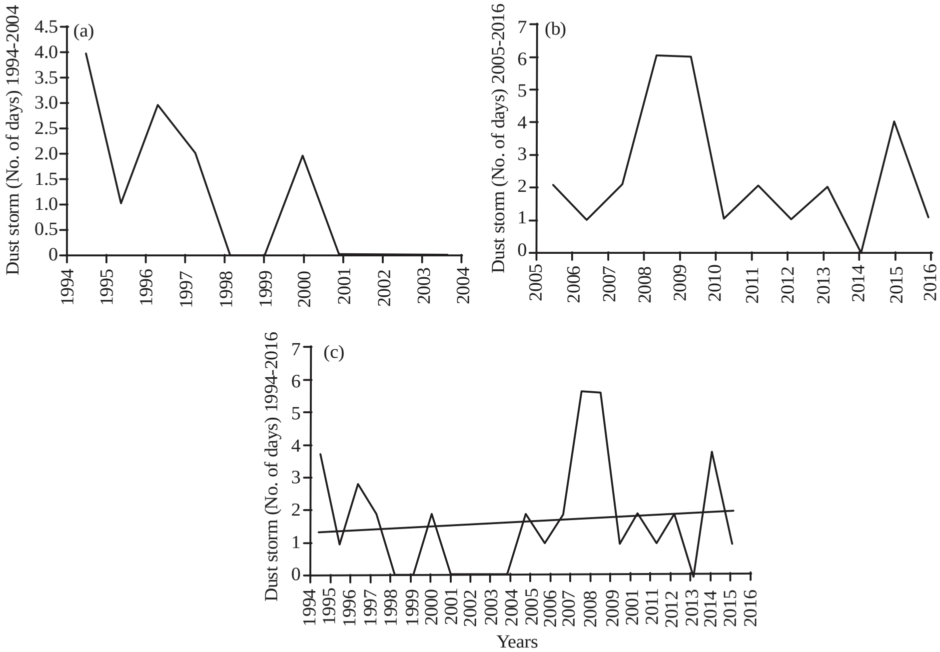


Fig. 12(a-c): Annual total of repeated days of suspended dust of Al-Azizyah's station

the second decade of the period of study 2004-2016 the total of repeated days of suspended dust was 201 days. The general trend of the total of repeating dust storms days for the period 1994-2016 is in increase.

**Al-Hay's station:** Through, Fig. 13 that includes annual total of repeated days of suspended dust of Al-Hay's station it has registered in the first decade of the period of study 1994-2004 the total of repeated days of suspended dust that was 85 days while in the second decade of the period of study 2004-2016 the total of repeated days of suspended dust was 223 days. The general trend of the total of repeated dusty storms days for the period 1994-2016 is up.

**Rising dust; Al-Azizyah station:** Through Fig. 14 that includes annual total of repeated days of rising dust of Al-Azizyah's station it has registered in the first decade of the period of study 1994-2004 the total of repeated days of rising dust was 111 days while in the second decade of the period of study 2004-2016 the total of repeated days of rising dust was 130 days. The general trend of the total of repeated dusty storms days for the period 1994-2016 is up.

**Al-Hay's station:** Through Fig. 15 that includes annual totals of repeated days of rising dust of Al-Hay's station it has registered in the first decade of the period of study 1994-2004 the total of repeated days of rising dust was 133 days while in the second decade of the period of study 2004-2016 the total of repeated days of rising dust was 111 days. The general trend of the total of repeated dusty storms days for the period 1994-2016 is Down.

**Wind erosion:** Wind is one of the most influential geomorphological factors in the formation of the earth surface, especially, the dry lands and it is the second factor after the running which is responsible for the erosion of the earth's surface. The scarcity of vegetation in the study area and the lack of air humidity that responsible for erosion of the earth surface. It is common knowledge that dry air has a great effect on sculpture rather than wet air. In general, the residual effects of wind in the forms of the earth surface depend on their speed, direction, periods of blowing and in addition to the roughness and cohesion of the formation of earth surface and plenty vegetation cover that is inversely associated with the wind. The wind speed increases with the decline of plant coverage which is reflected directly on its geomorphological ability in the processes of sculpture and sedimentation. The process of wind sculpting occurs in several stages. The process of deflation is to remove the rock breakers from the surface with the force of the wind while abrasion is the process of carving and destroying the surface of the earth with the force of the air rush and the ability or capacity of the wind holding rock fragments. These rock breakers are also eroded as a result of their friction with one another while they are transported in the air. The eroded fragments transported in several way such as suspension and traction or salutation. In the case of

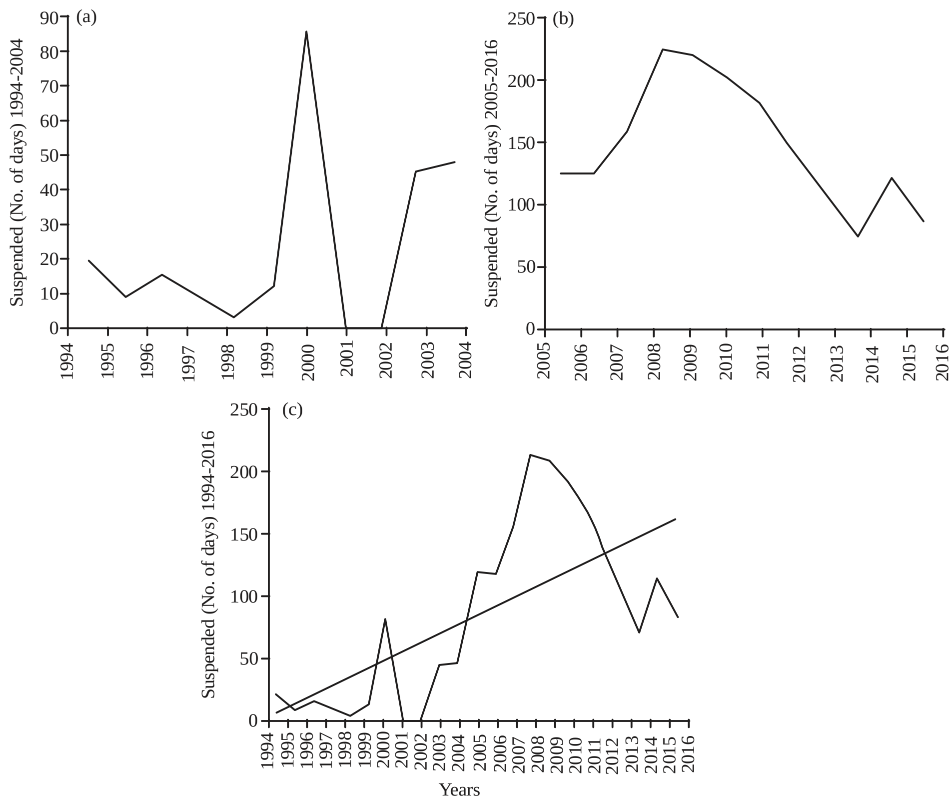


Fig. 13(a-c): Annual total of  repeated days of suspended dust of Al-Hay's station

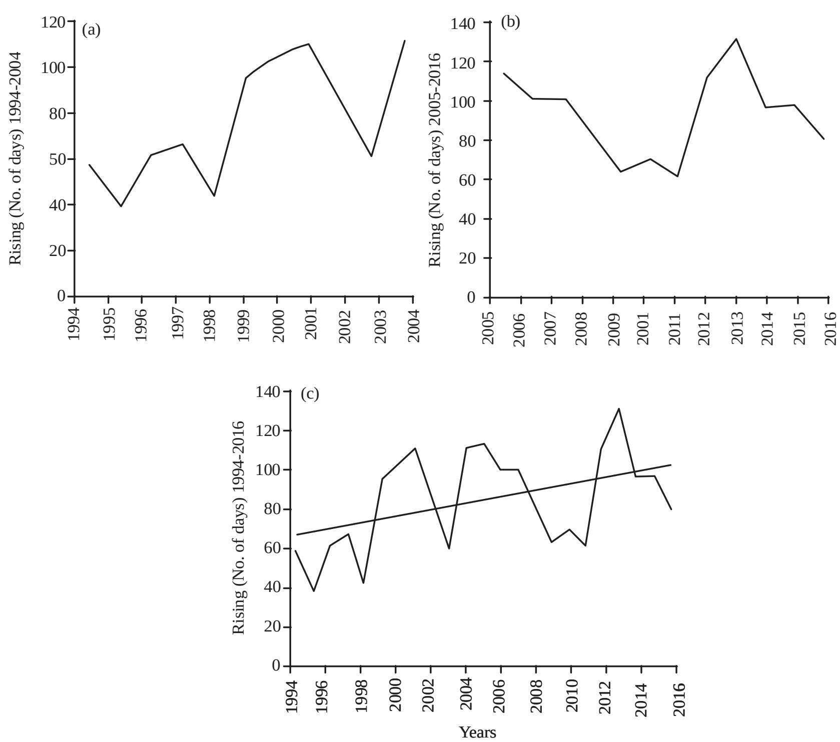


Fig. 14(a-c): Annual total of repeated days of rising dust of Al-Azizy's station

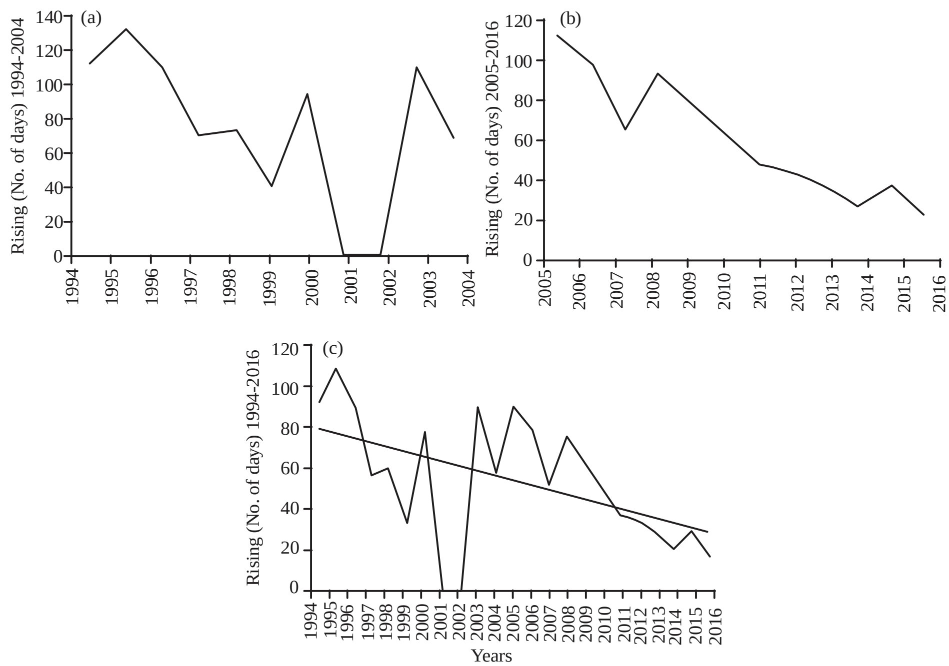


Fig. 15(a-c): Annual total of repeated days of rising dust of Al-Hay's station

Table 14: Wind proof of erosion

| Wind proof | Degree of erosion |
|---|---|
| <20 | Minor |
| 20-50 | Medium |
| 50.1-150 | Stiff |
| >150 | Very severe |

application of climatic viability of erosion a Siddoway and chepil equation is used to determine the viability of wind erosion in the study area, which depends on ability to two elements which are the adequacy of the fall of the Thornthite and the rate of wind speed as follows:

$$E = 386\frac{V^3}{(PE)^2}$$

Where:
E = Wind prove
V = Speed in
PE = Effective precipitation of Thornthite

The results showed that the wind speed at Al Azizia and Al-Hayy stations were 15.22 and 14.21, respectively and according to Table 14 they can be classified as minor erosion values. Of course, this is due to increasing the amount of falling rainfall as well as the presence of vegetation cover. Here comes the active role of chemical weathering and water erosion during the months of rainfall in which there is a surplus water.

They also depend on the annual values of climatic viability of erosion, without taking account of the seasonal variation of that susceptibility. The formula suggested by FAO in 1979 is therefore used as follows:

$$C = \sum 12\left\{\frac{^{3}\text{PETV-PN}}{\text{PET}}\right\}100$$

Where:
C = Annual climatic viability of erosion
V = Monthly rate of wind speed (m sec$^{-1}$)
PET = Monthly evaporation/transpiration rate (mm)
P = Monthly rainfall (mm)
N = Number of days of the month

The equation is classified into four categories (Table 15 and 16). Since, this equation is used in many arid regions to estimate the climatic viability of erosion, it is possible to calculate the monthly values of viability of erosion. After possible calculating the monthly rate of evaporation/transpiration which is the most important variable in the application of the equation which depend on the experimental value of method Thornthaite.

When applying the equation to the climatic stations close to the study area such as Aziziya and Al-Hayy stations (neighborhood station), the results of the equation indicate a variation in the monthly and annual values of the climatic viability of erosion as there is no climatic susceptibility during the winter months (December, January, February) in the above stations. This comes as a result of the actual increase in rainfall over the

Table 15: Monthly and annual rates of climatic viability of precipitation and climatic variables affecting them at Azizia station for the period 1994-2016

| Months | Wind speed m sec$^{-1}$ | Amount of precipitation (mm) | Evaporation transpiration possible | Ablutionc | C (%) |
|---|---|---|---|---|---|
| January | 3.2 | 27,7 | 6.9 | zero | zero |
| February | 3.4 | 12.7 | 12.9 | zero | zero |
| March | 3.8 | 15.9 | 38.9 | 10.05 | 0.10 |
| April | 3.7 | 13.2 | 97.6 | 13.14 | 0.13 |
| May | 5.0 | 4.0 | 233.4 | 38.08 | 0.38 |
| June | 5.0 | - | 366.6 | 37.5 | 0.37 |
| July | 5.1 | - | 460.3 | 41.12 | 0.41 |
| August | 4.3 | - | 409.2 | 24.64 | 0.24 |
| September | 3.5 | 0,1 | 245.1 | 12.85 | 0.12 |
| October | 3.1 | 9.8 | 125.7 | 8.51 | 0.08 |
| November | 2.8 | 23.9 | 31.4 | 1.57 | 0.01 |
| December | 3.0 | 17.8 | 10.3 | zero | zero |
| Average | 3.7 | - | 169.85 | 187.46 | 1.87 |

Depending on the scale (4.5)

Table 16: Monthly and annual rates of climatic viability of precipitation and climatic variables affecting the living station for the period 1994-2016

| Months | Wind speed m sec$^{-1}$ | Amount of precipitation (mm) | Evaporation transpiration possible | Ablutionc | C (%) |
|---|---|---|---|---|---|
| January | 3.0 | 28.3 | 5.7 | zero | zero |
| February | 3.4 | 14.8 | 11.3 | zero | zero |
| March | 3.5 | 19.4 | 36.7 | 6.26 | 0.06 |
| April | 3.6 | 13.1 | 108.9 | 12.31 | 0.12 |
| May | 3.6 | 5.6 | 272.2 | 14.16 | 0.14 |
| June | 4.9 | 0.1 | 439.5 | 35.28 | 0.35 |
| July | 4.8 | 0.3 | 565.1 | 34.26 | 0.34 |
| August | 4.4 | 0.0 | 496.5 | 26.40 | 0.26 |
| September | 3.8 | 0.2 | 314.0 | 16.45 | 0.16 |
| October | 3.1 | 4.9 | 146.1 | 8.92 | 0.08 |
| November | 2.9 | 20.6 | 45,7 | 4.01 | 0.04 |
| December | 2.8 | - | 9.3 | zero | zero |
| Average | 3.7 | - | 218.66 | 158.05 | 1.58 |

Depending on the scale (4.5)

monthly rates of evaporation/transpiration possible during those months. The increase in the rainfall at Aziziyah station for the above months are 17.8, 27.7, 12.7 mm, respectively with a total of 58.2 mm. While the amount of increase in the rainfall at the stations of the neighborhood for the months above are 20.6, 28.3, 14.4 mm, respectively with a total of 63.3 mm and that the surplus of rain water finds an outlet in Soils through peculation with medium and high permeability become highly humid. But the surplus of rainfall remain on the surface forming temporary pond in the soil with few pores (impermeable). This leads to the cohesion of the surface layer of the soil and it is not affected by wind erosion. On the other hands, the gradual decrease in precipitation, relatively high temperatures as well as increased wind velocity during the spring season have a negative impact on soil moisture content which helps to increase the climatic viability of precipitation during the spring months (March, April and May). The total climatic viability at the stations (Al-Azizia, Al-Hayy) for the spring months amounted to 61.27 and 32.73, respectively. In the summer where there is no rainfall and high temperature rise with monthly wind speed reaching its peak in June, July and August leading to dryness of the surface layer of the soil and disintegration to minutes, becoming easy to transport by wind. Thus, monthly averages of climatic viability of erosion are highest during this season with a total of 103.26 and 75.94, respectively. Monthly averages of climate variables that have a direct effect on susceptibility during autumn months (September, October, November) causing a decrease in the monthly rates of climatic viability of erosion during fall season and a total of 22.93 and 29.36, respectively.

The total annual value of the climatic viability for erosion of Al-Aziziyah station was estimated at 187.46 and was classified as very severe erosion according to the classification of the wind hypothesis. While the total annual value of the climatic viability for the Al Hayy station was recorded at158.05 and it is also classified as very severe erosion. But the value of the climatic capacity at Al-Aziziyah station exceeds the value of the Al-Hayy station by 29.41. This variation in values may be due to spatial variation between the two regions as well as variations in the values of climate variables that are directly correlated with climatic viability. Al Aziziyah station recorded significant increases in the monthly and annual rates of direct-impact on climate elements such as wind speed and possible evaporation/transpiration that exceeded the Al-Hayy station.

**Soil susceptibility to erosion:** Soil susceptibility to erosion is a quantitative measure of how much soil particles are lost per year from dry surface by wind. So, the stronger the wind, the greater the impact on the soil which lead to dry disintegrate and remove soil particles from the surface by wind erosion. When the force of pressure and wind speed on the loose soil particles is overcome by the force friction of the grain on the surface of the earth and the weight of the grains themselves, resulting in their separation from the surface and then moving, as illustrated by the following law.

Wind pressure force (kg m$^{-2}$) = 0.006×Wind speed box (km h$^{-1}$). Thus, the amount of wind pressure per square meter of the Earth surface is 0.12 kg if the wind speed is 4.5 m sec$^{-1}$ (16.2 km h$^{-1}$). This amount increases with the gradual wind speed increasing from March, in the monthly rates of wind speed to reach the highest rates in the station Azizia for months June, July and August, amounting to 0.15, 0.15 and 0.11 kg m$^{-2}$, respectively. However, in the Al-Hayy station for the same months above, it was 0.14, 0.313 and 0.9 kg m$^{-2}$, respectivley and it gradually differs from September until it reaches its lowest level in December at Al Aziziyah Station and for the same month at Al Hayy station. It is possible to estimate the intensity of the erosion in the region, depending on the surface of the earth from the aggregates and particles or scalable or non-ablution in the case of increasing the particles from 1 mm and when the proportion of the aggregates to 60%. Soil aggregates are the adjacent and interconnected soil particles due to the presence of a quantity of interstellar materials such as carbonates, organic or moisture content which makes them aggregate and increases their diameter to 1 mm or 0. The soil becomes almost completely resistance to erosion even at the wind speed (12.5 m $sec^{-1}$). In the case of decreasing percentage of the aggregates, the soil is more vulnerable to erosion and soil needs to be protected against wind erosion.

## CONCLUSION

Through studying the relationship between the climate's elements(temperature, winds, rains, humidity) and the dust phenomena (dust storms ,suspended dust, rising dust) for the two stations Al-Azizyah and Al-Hay at Wasit province for the period 1994-2016 and counting correlation coefficients shown the following.

Relationship between the climate’s elements (winds and temperature) with dust phenomena (dust storms, suspended dust and rising dust) is a trivial relationship. It means whenever temperature and winds increased the days of dust phenomena increased. Relationship between the climate’s elements (rains and humidity) with dust phenomena (dust storms, suspended dust and rising dust) is an inverse relationship. It means whenever rains and humidity increased the days of dust phenomena decreased.

Dusty storms phenomena is repeated during all months of the year and they increase in summer due to the cease of rain, rise of temperature and increase in winds speed. Annual total of repeated dust storms phenomena has registered the higher level at Al-Azizyh’s station more than the days of dust storms, it was 17 days in 2012 and less total of dust storms days was 0 in the years 1995, 1996, 1997, 1998, 1999, 2002, 2006 and 2014. As for the suspended dust, it has registered the higher total in 2016 and it was 192 days and lower total has registered in 1995 and it was 12 days. As for the rising dust it has registered a higher total in 2013 and it was 130 days and lower total was in 1995 it was 39 days.

Annual total of repeated dust storms phenomena has registered the higher level at Al-Hay’s station more than the days of dust storms, it was 6 days in 2008 and 2009 and less total of dust storms days was 0 in the years 1998, 1999, 2000, 2001, 2002, 2003 and 2014. As for the suspended dust it has registered the higher total in 2008 and it was 223 days and lower total has registered in 1998 and it was 3 days. As for the rising dust, it has registered a higher total in 1995 and it was 133 days and lower total was in 2016, it was 22 days.

The erosion equation indicates a variation in the monthly and annual values of the climatic viability of precipitation at the stations. There is no climatic susceptibility during the winter months (December, January and February) in the above stations, The monthly rates of evaporation/transpiration possible during these months. The increase in the station of Aziziyah for the above months 17.8-27.7-12.7 mm, respectively with a total of 58.2 mm while the increase in the station station. For the above months 20.6-28.3-14.4 mm, respectively, with a total of 63.3 mm.

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