Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

ANALYSIS OF DUST STORMS IN ERBIL CITY-IRAQ USING SURFACE OBSERVATIONS AND GIS TECHNIQUES

Rebin Samad Abdullah

Department of Surveying, College of Technology, Erbil Polytechnic University, Erbil, Kurdistan Region, Iraq.

ABSTRACT

Dust storms are a common phenomenon in desert and semi-desert areas, they arise when the wind blows and has the ability to soil grains transfer particles from the Earth's surface and carry them over distances determined by the wind speed and the size of the particles, when this occurs Winds with a speed between (7-8) of per second and at a height of one meter have the ability to can erode soil and transport it over long distances through wind erosion. However, the geography of the study area distant from desert regions, but it is affected by global environmental changes, like most other regions of the world. Erbil city experiences the phenomenon of dust storms, to measure the amount of dust deposition in Erbil, a special glass surface measuring one meter in length and width, equipped with glass, was used to collect dust particles. A scientific analysis of dust deposition was conducted in 2024 according to the results, the maximum amount of dust deposition recorded in Erbil city was 3.5 grams in September, and the minimum of dust deposition is recorded in May 2024 was 1.2 grams, the total area corresponding to the dust deposition in Erbil in 2024 is approximately 383km, Average dust deposition per square meter in Erbil in 2024: 28.21grams , the Total of dust deposition from Erbil city in 2024: 10.8 tons .for the comparison and analysis of the resulting data, a geographic information system (GIS) is used.

Keywords: Pollution, Gram, Area, Geographic, Deposition

Received: 14/4/2025, Accepted: 2/7/2025, Published: 26/1/2026

INTRODUCTION

Dust pollution is one of the environmental phenomena that has garnered significant attention in recent years. This phenomenon is considered a global issue and is regarded as a major challenge among environmental policymakers in general, and agricultural producers in particular. (Akhlaq, et al. 2012). Environmental Pollution: This term refers to the process of disrupting the natural balance of the environment, which adversely affects the lives of living organisms. It is classified as an unnatural phenomenon that harms the environment and is caused by pollutants that introduce negative changes in nature., These changes can lead to catastrophic consequences, potentially resulting in environmental destruction. Water and soil pollutants threaten farmers' ability to produce the food necessary to sustain the world's population. Similarly, marine pollutants endanger numerous marine organisms (Al-Maamouri, 1996). Climate Change: The phenomenon of climate change is defined as an imbalance in the usual climatic conditions, such as temperature, wind patterns, and precipitation, that characterize each region on Earth. The pace and magnitude of long-term, comprehensive climate changes lead to significant impacts on natural biological systems. Rising temperatures will result in changes to weather patterns, including shifts in wind patterns and alterations in the amount

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

and types of precipitation. Additionally, the occurrence of several extreme climatic events is likely, leading to widespread and unpredictable environmental, social, and economic consequences (Srwa, 2022). The climate of Erbil city, with its various elements, is considered a fundamental focus in studies of the natural environment due to the significant influence of its components—solar radiation, heat, rainfall, atmospheric pressure, and winds on human activities and various other aspects of life. According to the Köppen classification, the city of Erbil, located on a plain, falls within the semi-arid steppe climate region (BS). This climate is characterized by hot, dry summers and cold, rainy winters (Qadir, 2020), During the hot season of the year, the research area is influenced by the Indian monsoon low due to high temperatures, while the opposite occurs during the cold season, leading to the formation of high atmospheric pressure centers, such as the Siberian high, which is concentrated over northern Eurasia. The significant difference in the city's atmospheric pressure characteristics and their impact on prevailing winds their direction and speed contributes to the formation of dust storms. Winds act as a mechanical force that transfers thermal energy and water vapor, resulting in changes in weather phenomena across different areas of the city. the prevailing winds in the study area are the northwesterly winds, which are characterized by high temperatures and dryness. The region is often exposed to these winds, which are frequently accompanied by dust (Abdullah, 2013). the most important reasons for the occurrence of the dust deposition phenomenon in the Erbil city are as follows:

1. The main factor for the occurrence and increase of dust is drought due to lack of rain, which leads to the occurrence and increase of dust. (Al-Dulaimi, 1999)
2. The prevailing wind speed and direction, air masses and differences in atmospheric pressure. (Al-Bayati and Attia, 2011)
3. The type and density of vegetation cover, due to the lack of vegetation cover in the region, which is the main source of dust. and lack of green spaces inside the city and on its outskirts (Rasul, et al 2016).

First - Importance of the Research; Erbil Governorate is located in the Erbil Plain, as it is located on the western side of the mountainous region. It is believed that most of the blame lies with the Iraqi desert for the occurrence of the dust phenomenon and its spread to different parts of the city of Erbil, while. The purpose of this qualitative study was to determine and distribute the percentage of dust in the city of Erbil in the year 2024.

Second - The core issue addressed by this study lies in understanding Analysis of Dust Storms in Erbil City-IRAQ Using Surface Observations and GIS Techniques.

Third - Research objective: The study aimed to explore the occurrence of dust storms and record their timelines to provide a useful reference for predicting future dust storms. Dust storm events and their relationship to climate change in Erbil city during the past year 2024 were analyzed using surface observations in Erbil city.

Fourth - Research hypothesis – The amount of dust precipitation in Erbil city is significantly higher during spring and autumn compared to other seasons due to seasonal weather patterns and climate change. And distribution and comparison of the results regarding the amount of sand, along with the achievement of the research objectives.

Fifth - Study Methodology: The study methodology involves analytical and comparative data analysis. The concentrated geographical location of Erbil city makes it particularly vulnerable to dust storms, which

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

are influenced by regional climatic patterns and surrounding terrain.

Sixth - The literature review: In order to start from what the researcher has reached in this field, a group of previous studies were addressed by reviewing their content, as follows:

Table 1. A Review of Previous Studies on Dust Storms in Iraq and Other Regions

No	Years	Name	Research	Country - City
1	2020	Rezhen Akram Qadir	Dust Storms and Their Health Causes in Erbil City	Iraq-Erbil
2	2013	Riyadh Muhammad Al-Masoudi	Dust storms in Karbala Governorate,	Iraq- Karbala
3	2024	Ahmad Abdullah	Comparative analysis of Sandstorms frequency in IABM – Saudi Arabia	Saudi Arabia
4	2022	Saha Fazl Abas	Dust storms in Basra Governorate	Iraq-Bassra
5	2012	Qusai Y. Al-Kubaisi and Lookman M. M. Gardi	Dust storm in Erbil city as a result of climatic change in Kurdistan Region Iraq	Iraq - Erbil

This review of previous studies, through an analysis of their contents, focused on examining the factors influencing the recurrence of dust storms in Iraq. The studies also emphasize defining the phenomenon, classifying it, and analyzing the most significant factors contributing to its recurrence. Additionally, they aim to explore the spatial characteristics of the phenomenon and the temporal patterns of its recurrence in Iraq.

2.Methodology and data collection

2.1. Study area: Erbil city is one of the oldest continuously inhabited cities in the world, where life still thrives. Located in northern Iraq, it is distinguished by its position in an area of undulating lands, situated within a flat region known as the Erbil Plain (25). The city serves as the center of the Erbil Governorate and the capital of the Kurdistan Region of Iraq, making it an administrative, political, and demographic hub. In terms of population, the city's total population, according to the final results of the most recent census conducted in the study area in 2024, is 1,131,080 people, as reported by the Planning Department of Erbil City (16).

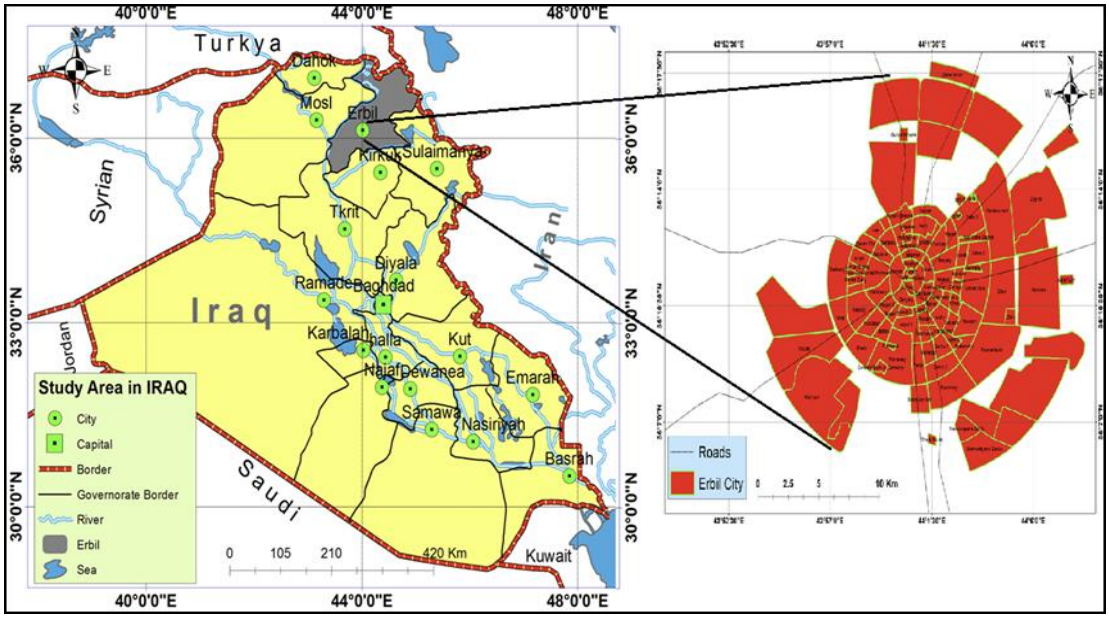
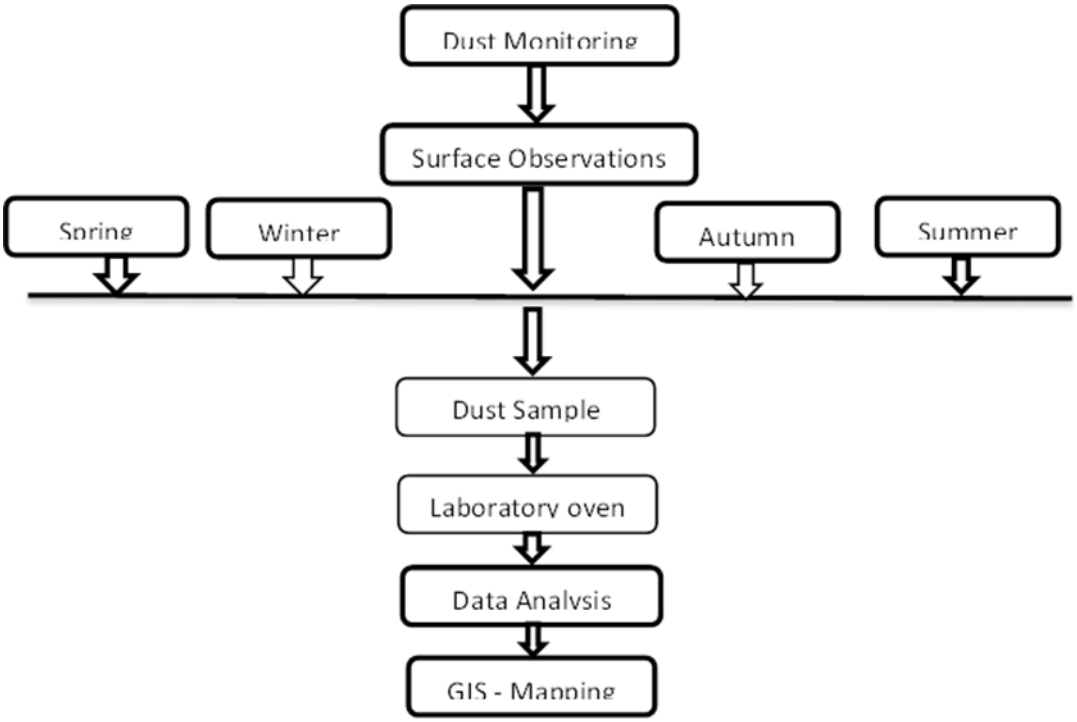


Figure 1. Study Area (Erbil City) in Iraq

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

Astronomically, the study area is located between latitudes (36.18.15.2) (36.05.30.2) north and longitudes (44.09.19) and (43.54.16.14) east, thus it is located in the northeastern part of Iraq, and it also occupies a central location with respect to the Kurdistan Region of Iraq, as it is in the middle with an increase in inclination towards the north and northwest. As for the area of Erbil city in 2024, the total area of Erbil city is about 383 Km2 (Rasul, A., Balzter, and Smith, 2016).

2.2. Data collection and analysis: The data collection for this article was conducted in two ways. The first method involved gathering data from the study area, specifically from the Kurdistan Regional Government (KRG) and Erbil Governorate. the second method involved monitoring surface observations through fieldwork conducted over one year at various sites within Erbil city. in order to obtain field and scientific data on the amount of dust in Erbil city, we used a detailed and scientific method. to measure monthly dust accumulation, the following procedure was used: To monitor the amount of dust deposition in Erbil, a 1m × 1m glass surface was used. This standardized surface ensures consistent measurements. The height around the plant was set at 20 cm, possibly to simulate a specific environment or to ensure uniformity in the experiment. Dust accumulated on the glass surface was collected once a month, indicating a long-term study to track dust levels over time, the plant was cleaned using laboratory-distilled water to avoid contamination from impurities in regular water. the collected dust was dried in a specialized laboratory oven for 24 hours to remove moisture and ensure accurate weight measurements. After drying, the dust's weight was measured to determine the monthly dust accumulation.



Total area × Mean data analysis = The dust percentage in Erbil City was analyzed and recorded. Total area = Total dust precipitation / Average dust precipitation. After obtaining the dust weight for each month, it was directly correlated with the dust precipitation rate to Geographical Distribution of dust accumulation. These data were then analyzed and mapped using GIS.07 (Geographic Information System), GIS was used to create heat maps of dust distribution and analyze spatial trends in Erbil City. This system helps

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

create various maps and conduct data analysis, providing valuable insights into the environmental impact of dust storms in the region. and an example for local technologies are proximal, Kriging, B-splines technique and Inverse Distance Weighting (Kriging).

RESULT AND DISCUSSION

Geographical distribution of dust deposition in erbil city: There is no doubt that dust deposition has become a contemporary and recurring phenomenon that most cities in the world suffer from. They are a familiar natural climatic phenomenon in Iraq, including the Kurdistan Region of Iraq, especially in recent years. The phenomenon began to record continuous recurrences due to the climate changes witnessed by the research area, represented by the rise in temperatures, the decrease in rainfall, and the change in wind speeds carrying quantities of dust and silt in the region as a result of successive years of drought that cast their shadows and effects on the components of the environment in the Kurdistan Region in general and the Erbil Governorate and the city of Erbil in particular, especially after 2003 (Rashid, 2011). This phenomenon has become the most common in the city and has attracted the attention of many specialists in several fields. Therefore, it has become imperative to pay sufficient attention to this topic due to its direct impact on various environmental systems and its connection to human life, as it is one of the important components of the geographical environment that is affected by it and interacts with it. Thus, the phenomenon of dust and sand storms is a renewed issue that has emerged as a result of climate changes, which has negatively affected all human activities in the city (Al-Masoudi, 2013), the impacts of desertification and dust storms, caused by poor land management and insufficient vegetation cover, are significant, Analysis and Geographical Distribution of Dust Storms in Erbil City are as follows:

Analysis of dust deposition from january to april: As shown in Table 2, the dust precipitation in January ranges as follows: the highest dust precipitation is 2.9 grams for m2, and the lowest is 1.1 grams of m^2. and average of dust in Erbil city was analyzed during of January are 2.15gram to m^2, the total dust in Erbil City for the month of January 2024 reached 823,450 grams.

Table 2. Comparison of Dust Level Across Seasons In Erbil City

Month	Lowest Dust Level (grams)	Highest Dust Level (grams)	Trend
January	**1.1**	**2.4**	**Very low dust levels.**
February	**0.8**	**2.8**	**low increase in dust.**
March	**1**	**2.8**	**Slight increase from March.**
April	**1.1**	**2.9**	**Stable, similar to April.**

Table,2. shows The data analysis included descriptive statistics for dust levels in Erbil City, the dust precipitation in February ranges as follows: the highest dust precipitation is 2.8 grams for m2, and the lowest is 0.8 grams of m^2. and average of dust in Erbil city was analyzed during of January are 2.15gram to m2, the total dust in Erbil City for the month of January 2024 reached 804300 grams. According to the analytical data obtained in March, Table 2 and Figure.2 shows that the average dust precipitation in Erbil was 1.4 grams, but the highest dust precipitation was 2.8 grams in some places and neighborhoods of Erbil. The highest dust precipitation in April was 2.9 grams in some neighborhoods, but in other neighborhoods the lowest dust precipitation was 1.1 grams.

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

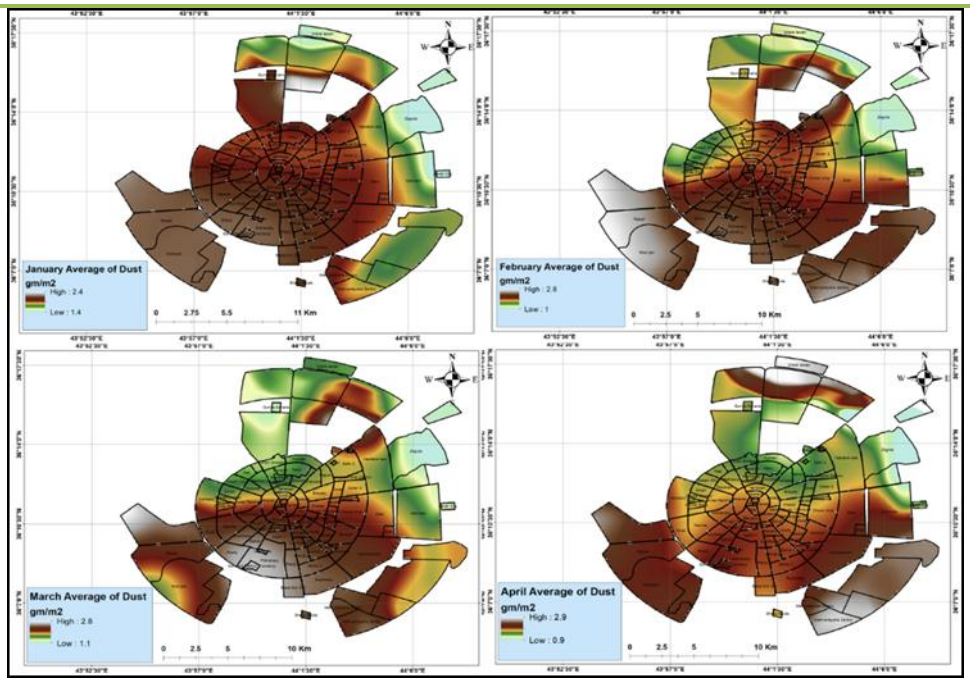


Figure 2. The Spatial Distribution Of Average Dust In Erbil City and Analyses During The Months Of January, February, March, And April

Looking at Figure 2, the spatial distribution of average dust in Erbil city was analyzed for the months of January, February, March, and April. It is evident that the amount of dust in Erbil varies across different neighborhoods. Comparing the months of January, February, March, and April, the highest dust concentration was observed in March. by analyzing and evaluating the maps, it is evident that the highest amount of dust occurred in the southern and western parts of Erbil, this is due to the high population density, lack of greenery, traffic congestion, and the presence of many factories and industrial zones in the southwestern part of Erbil city, the brown area on the map indicates regions with more than two grams of dust precipitation. This elevated level of dust may be attributed to human activities**,** the amount of dust that settles over a specific area over a given period, a measurement of more than 2 grams indicates a significant amount of dust deposition, which could have environmental, health, or infrastructural implications.

Analysis of dust deposition from may to august: Table, 3. shows The data analysis included descriptive statistics for dust levels in Erbil City, the dust precipitation in may ranges as follows: the highest dust precipitation is 1.7 grams for m2, and the lowest is 1.2 grams of m2. and maximum of dust in Erbil city was analyzed during of June and July, August between (2.2 to 2.5) gram to m^2.

Table 3. Comparison Of Dust Levels Across Months In Erbil City

Month	Lowest Dust Level (grams)	Highest Dust Level (grams)	Trend
May	**0.1**	**1.7**	**Very low dust levels.**
June	**0.4**	**2.5**	**Significant increase in dust.**
July	**0.3**	**2.3**	**Slight decrease from June.**
August	**0.8**	**2.2**	**Stable, similar to July.**

Dust storms affect the research area in the summer and spring seasons, where dust storms increase due to the presence of a high-pressure area over the mountainous lands in Turkey, which is met by a low-pressure area centered over the Arabian Gulf, in addition to the

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

widespread influence of the semi-stable seasonal pressure system in the summer. According to the variation in the speed and capacity of the convective winds, the variation in their ability to erode, winnow and sweep is noted. The wind speed rates in the city of Erbil show an increase with the beginning of the summer months,

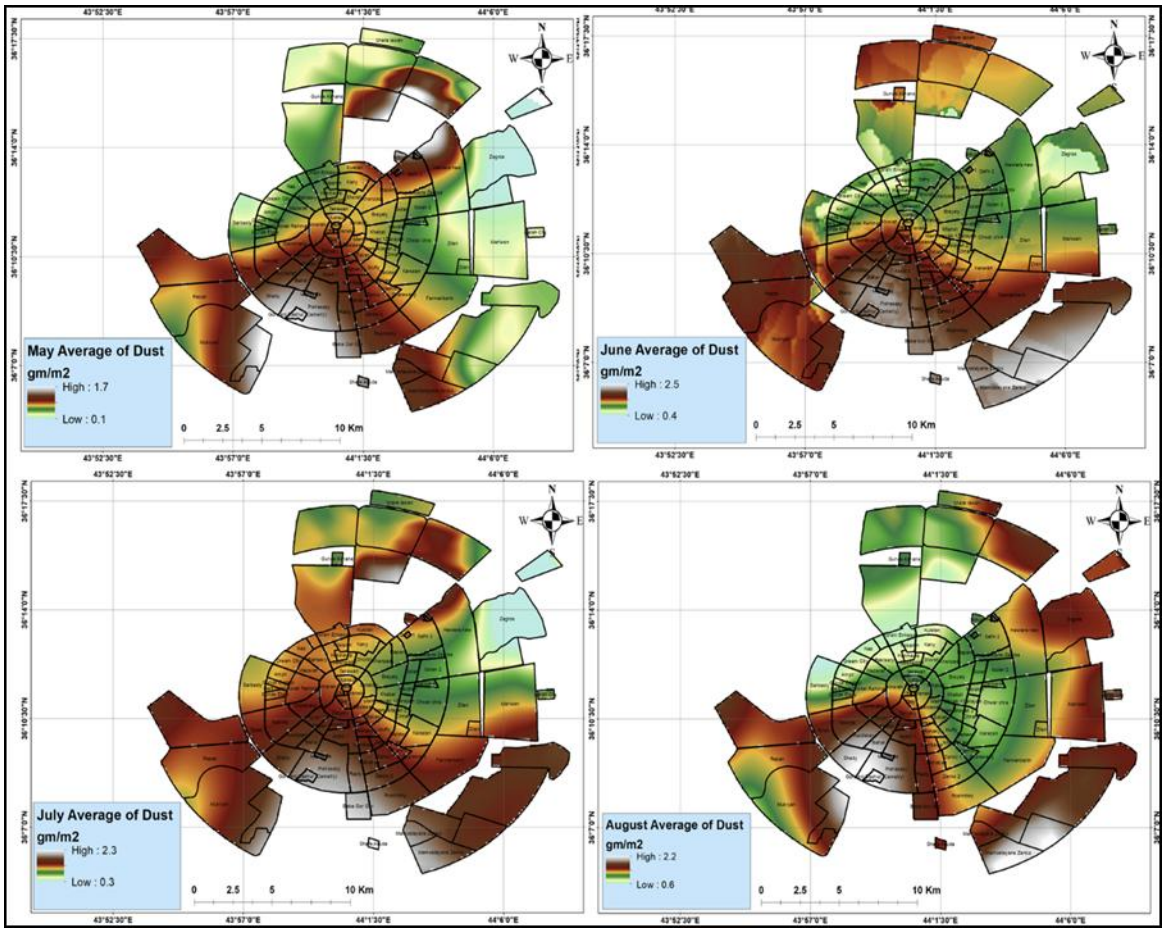


Figure 3. The Spatial Distribution Of Dust In Erbil City Was Analyzed During The Months Of May, June. July, And August

Figure.3, shows the spatial distribution of average dust deposition in Erbil city was analyzed during the months of May, June, July, and August. The dust levels in Erbil city during May were very low, ranging between 0.1 to 1.7 grams across neighborhoods. This indicates favorable air quality and minimal health risks related to dust exposure. Dust levels are lowest in May and gradually increase from June onward, peaking in June (2.5 grams) and remaining high in July and August (up to 2.3 grams). This trend aligns with typical seasonal patterns in arid and semi-arid regions, where dust levels rise during the hotter and drier summer months.

Analysis of dust deposition from september to december: Table, 4. Shows, the data analysis included descriptive statistics for dust levels in Erbil City. In September 2024, the highest amount of dust recorded in Erbil was 4 grams, while the lowest amount was 1.7 grams and significant increase in dust. This represents a significant increase compared to the average dust levels typically observed in the city, the rise in dust may be attributed to a combination of weather conditions, human activities, and regional dust storms. Then, in October, November, and December, the amount of dust decreased very rapidly, with dust levels in these months ranging between 0.3 and 3.4 grams in Erbil city,

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

Table 4. Comparison Of Dust Level Across Months In Erbil City

Month	Lowest Dust Level (g)	Highest Dust Level (g)	Trend
September	**1.7**	**4**	**Significant increase in dust.**
October	**1.2**	**3.2**	**Rapid decrease from September.**
November	**0.5**	**3.2**	**Continued low dust levels.**
December	**0.3**	**3.4**	**Stable, low dust levels.**

After September month in Erbil, the dust precipitation recorded in October is 3.2 grams per square meter, likely due to strong winds and dry conditions. In contrast, the lowest recorded value is 1.2 grams per square meter, occurring during periods of calm weather or rainfall. This wide range highlights the variability in dust levels during the autumn season, then in November and December, the amount of dust will decrease in Erbil city and Stable, low dust levels.

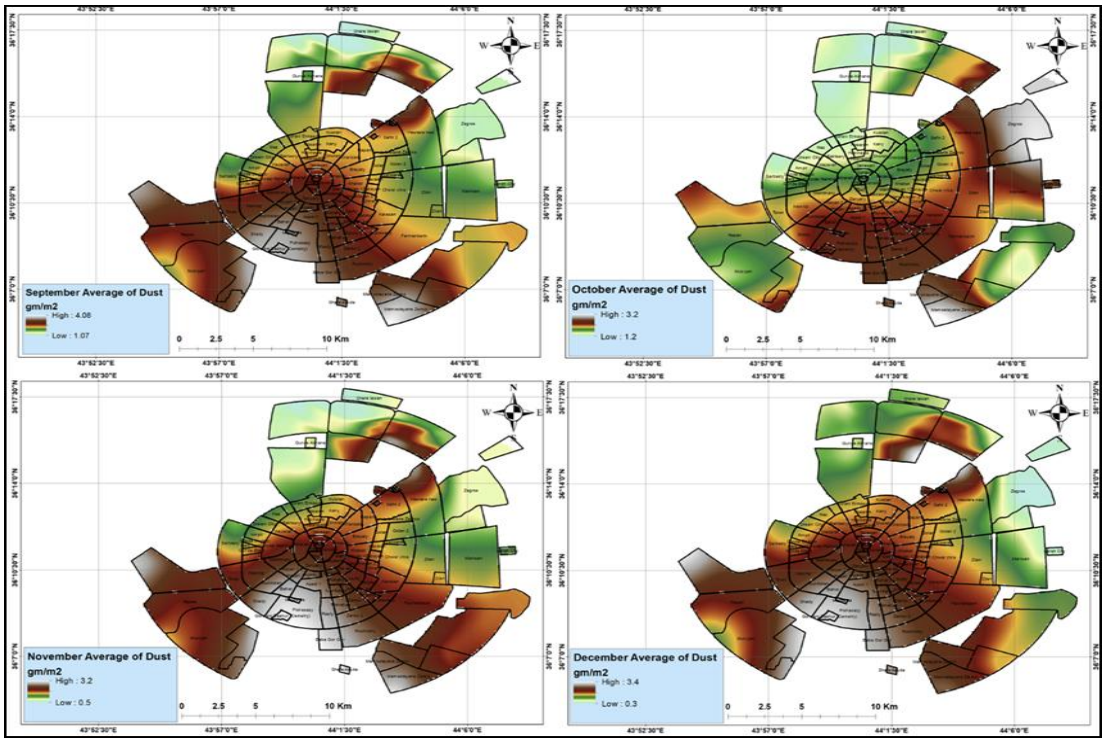


Figure 4. The Spatial Distribution Of Average Dust In Erbil City Was Analyzed During The Months Of September, October, November, And December

Dust deposition levels decreased rapidly from September to October, continuing through November and December. The lowest dust level recorded during these months was 0.3 grams, indicating a return to much cleaner air conditions. Dust levels peak in September (1.7 to 4 grams) and decline rapidly in October, November, and December (0.3 to 3.4 grams). This pattern aligns with typical seasonal changes in arid and semi-arid regions, where dust levels are highest during the dry, hot months and decrease during cooler, wetter periods. From October to December, dust levels in Erbil decreased rapidly, ranging between 0.3 and 3.4 grams. This decline marks a significant improvement in air quality compared to September, when dust levels were at their highest (1.7 to 4 grams). The reduction is likely due to seasonal changes, including increased rainfall, calmer winds, and reduced human activities. Maintaining efforts to monitor and control dust will help ensure continued improvements in air quality throughout the year. in general, brown areas

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

on the map indicate higher dust precipitation compared to green areas. This means that the brown areas are exposed to high dust precipitation, particularly in the southwestern part of Erbil city.

Comparison of dust deposition levels across months in erbil city: The dust storms that blow over the city of Erbil, in general, have their causes, paths, and effects, and they are strongly linked to environmental changes, the difference in temperature from one region to another, especially in open areas outside cities, leads to significant changes in atmospheric pressure (Qadir, 2020), This temperature rise, caused by prolonged exposure to sunlight during the day, disturbs air masses, causing them to move along multiple paths toward areas of low pressure and higher temperatures. As they move, they carry fine dust particles that contribute to dust storms, Meanwhile, hot winds in these regions rise upward, carrying large amounts of dust and dust particles to certain heights in the atmosphere. As these winds cool and slowdown in the upper atmosphere, the dust descends due to Earth's gravity, forming dusty atmospheres (Al-Naama, 2009) in general, there are two main factors responsible for generating dust storms in the city:

1- Natural factors: drought ,low vegetation cover, and strong winds. high temperatures,

2- Human activities: Bad land use and land cover changes. (Al-Dulaimi, 1999) High annual temperatures, low annual rainfall in recent years, and frequent droughts in the city have contributed to the increased and recurring occurrence of dust storms. And Several factors have led to the recurrence of dust storms in the city. Natural sources include global warming, high temperatures, and low rainfall (Khadim, 2012), Human-caused sources include increased concentrations of polluting gases in the atmosphere due to traffic congestion, a rise in the number of vehicles and industries, and the misuse of land through urban expansion at the expense of agricultural areas, dust storms occur most frequently in the city during summer, followed by autumn, spring, and winter (Al-Kubaisi, and Gardi, 2012), table 5 shows that the average amount of dust per square meter in January is 2.15 grams, while the average for Erbil is 823 kilograms. However, the amount of dust in February is 2.1 grams per square meter, while the average for the area of Erbil was 804 kilograms, the amount of dust in March increased to 2.83 grams per square meter, the proportion of dust in April was less than in March, which analyses and recorded 2.5 grams.

Table 5. The Average Dust Deposition In Erbil City

Month	Area (m^2)	Average dust storm ($g.m^2$)	Analyzed and Recorded (g)
January	**383,000,000**	**2.15**	**823,450**
February		**2.1**	**804,300**
March		**2.83**	**1083,890**
April		**2.5**	**957,500**
May		**1.2**	**459,600**
June		**2**	**766,000**
July		**1.97**	**754,510**
August		**1.32**	**505,560**
September		**3.5**	**1340,500**
October		**2.9**	**1110,700**
November		**2.84**	**1087,720**
December		**2.9**	**1110,700**
Annual total		**28.21**	**10.8 Ton**

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

Average dust precipitation = 28.21 g/m².
Total area = Total dust precipitation / Average dust precipitation.
Total area = 10,800,000 g / 28.21 g/m² ≈ 383,843,000 m².
Total dust precipitation = 10.8 tons = 10.8 × 1,000,000 = 10,800,000 grams.
By August, the amount of dust had decreased to less than 1.32 grams. The average amount of dust in August across all neighborhoods of Erbil was 505 kg, which was a very low proportion compared to the other months of 2024, and Average dust precipitation = 28.21 g/m² all neighborhoods of Erbil from 2024, and September will record the highest dust precipitation of any month in 2024, reaching 3.5 grams. In November and December, the amount of sand remains high at 208 grams. The average dust precipitation for the year 2024 in Erbil is 10.8 tons.

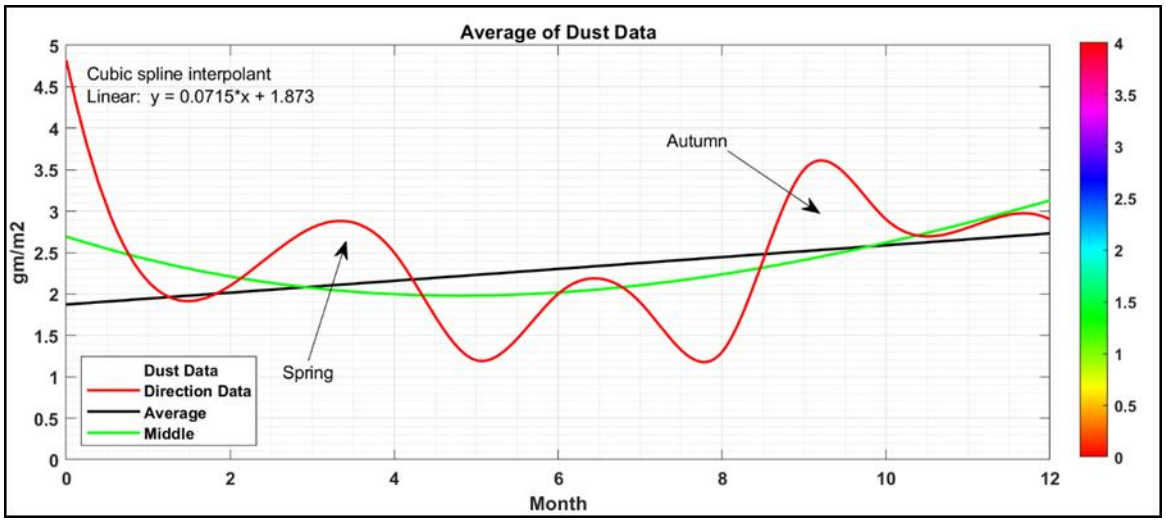


Figure 5. The Proportion Of Dust Deposition From Erbil City In 2024

Analyzing Figure.5, The proportion of dust deposition from Erbil city in 2024, we conclude that sand precipitation reached its highest levels in March and September, recording 3.5 and 2.8 grams, respectively, during spring and autumn. This is attributed to seasonal changes and the effects of climate change, during the hot season of the year, the research area is subject to the influence of the Indian monsoon depression as a result of the high temperature values, while the opposite occurs during the cold season of the year, which helps to form high pressure centers represented by the Siberian high, which is concentrated over northern Eurasia. As a result of the large difference in the characteristics of the city's atmospheric pressure and its impact on the characteristics of the prevailing winds, their directions and speed, it affects the formation and formation of dust storms. Winds are a mechanical means that work to transfer thermal energy and water vapor and the resulting changes in weather phenomena between different areas of the city. The prevailing winds in the study area are the northwesterly winds, which are characterized by their high temperature and dryness. The region is often exposed to winds accompanied by dust (Abdullah, 2013). The reason for the blowing of these winds is the presence of a high-pressure area over the mountainous lands in Turkey, opposite to a low-pressure area concentrated over the Arabian Gulf, which makes the study area a regular passage for these winds during the summer, and their blowing is intermittent during the winter due to the passage of hurricanes coming from the Mediterranean Sea (Al-Khalidi, et al. 2021).

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

CONCLUSION

The results indicated that Erbil is geographically distant from desert regions, but it is still affected by global environmental changes, like most other parts of the world. For example, Erbil experiences dust storms. According to the results, the maximum amount of dust recorded in Erbil city was 3.5 grams in September month, while the minimum amount, recorded in May 2024, was 1.2 grams. The average dust precipitation per square meter in Erbil in 2024 was 28.21 grams, and the total dust deposition precipitation for the city in 2024 was 10.8 tons.

Recommendation: Increase vegetation cover in urban areas to reduce wind erosion and dust suspension. Better land-use organization and utilization

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

REFERENCES

- Abdullah, Abdul-Jabbar. (2013). Characteristics of severe dust storms (haboob) in Iraq. A study published in the US Air Force Weather Agency (FORCE WEATHER AGENCY AIR), and translated and published by Dr. Salar Ali Khader and others in the Journal of the College of Arts, Issue 100.
- Akhlaq, M., Sheltami, T. R., and Mouftah, H. T. (2012). A review of techniques and technologies for sand and dust storm detection. Reviews in Environmental Science and Bio/Technology, 11, 305-322.
- Al-Khalidi, J., Bakr, D., and Abdullah, A. A. (2021). Synoptic Analysis of Dust Storm in Iraq. EnvironmentAsia, 14(1).
- Al-Kubaisi, Q., and Gardi, L. (2012). Dust storm in Erbil city as a result of climatic change in Kurdistan Region Iraq. Iraqi Journal of Science, 53(Remote Sensing-Conf), 40-44.
- Al-Naama, Hussein. (2009, October, 13). Dust storms: causes, effects, and treatments. A topic published in the Noon News Agency. On the following website: http://google http://non14.net/6317/
- Badr Jadoo Al-Maamouri, Dust storms in central and southern Iraq and methods of treating them, University of Baghdad, Al-Ustadh Magazine, Issue 58, Year 1996, pp. 148 - 131.
- Al-Yasin, Y. T. M. (1985). A Critical Analysis of Modernization in Kuwait as Reflected by Selective Print Media, 1960-1982. Wayne Sta
- Firas Fadhel Mahdi Al-Bayati and Khaled Ali Attia, (2011),The Impact of Dust Storms and Their Forms on Human Health, Journal of the Geographical Society, Volume 2, Issue 66.
- Hassan, T. K. (2022). The Impact of Architectural Crawl towards Agricultural Lands in Erbil Via Geographical Information Systems (GIS). Journal of Tikrit University for Humanities, 29(9), 251-277.
- Hassan, T. K. (2022). The Impact of Architectural Crawl towards Agricultural Lands in Erbil Via Geographical Information Systems (GIS). Journal of Tikrit University for Humanities, 29(9), 251-277.
- Khadim, M. (2012). The detection of dust storms using metsats salilites. Iraqi Journal of Science, 53(Remote Sensing-Conf), 116-124.
- KRG,Erbil Governorate,2024 , Planning Department, Unpublished data.
- Al-Saedi, M. S., Naimi, S., and Al-Sharify, Z. T. (2023, July). A comprehensive review on the environmental impact of the climate change on water flow rate and water quality in Tigris River. In AIP Conference Proceedings (Vol. 2787, No. 1). AIP Publishing.
- Khalaf, H. R., and Ismail, N. H. The Political Dispute Between the Government of Jaafar Muhammad Nimeiri and the Sudanese

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

Communist Party and Its Impact on the Internal Situation 1970-1971. International journal of health sciences, 6(S6), 1504-1516.

- 19.Mahdi Hamad Farhan Al-Dulaimi, The Impact of Climate on Human Health and Comfort in Iraq, College of Education, University of Baghdad, Master's Thesis, 1999, p. 92
- Qadir, R. A. (2020). Dust storms and their health causes in Erbil city. Qalaai Zanist Journal, 5(1), 450-498.
- Rashid, Imad Khuraibat. (2011). A study of the effect of some atmospheric elements on dust storms in selected areas of Iraq. A research published in Al-Mustansiriya Journal of Sciences, Volume 22, Issue 311, pp. 4-4.
- Rasul, A., Balzter, H., and Smith, C. (2016). Diurnal and seasonal variation of surface urban cool and heat islands in the semi-arid city of Erbil, Iraq. Climate, 4(3), 42.
- Riyadh Muhammad Al-Masoudi, (2013), Dust storms in Karbala Governorate, Al-Baheth Magazine, University of Karbala, Issue 5, pp. 3-5.
- Srwa sadradin nuradin , Food industry development from Erbil , Master's thesis , University of Koyi ,2022,p3.
- Taghreed Ahmed Omran Al-Qadi, (2006), The effect of thermal depressions on the weather and climate of Iraq, PhD thesis, unpublished, University of Baghdad, College of Arts, 2006. P. 23.

Iraqi Journal of Agricultural Sciences –2026:57(1):307-319
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/d6qwft09

تحليل العواصف الغبارية في مدينة أربيل–العراق باستخدام الرصدات السطحية وتقنيات نظم المعلومات الجغرافية

ريبين صمد عبدالله

المستخلص

العواصف الغبارية ظاهرة شائعة في المناطق الصحراوية وشبه الصحراوية، تنشأ عندما تهب الرياح ولها القدرة على نقل حبيبات التربة من سطح الأرض وحملها لمسافات تحددها سرعة الرياح وحجم الجسيمات، فعندما يحدث هذا فإن الرياح التي تتراوح سرعتها بين (٧–٨) عقدة في الثانية وعلى ارتفاع متر واحد لها القدرة على تآكل التربة ونقلها لمسافات طويلة من خلال التعرية الريحية. ومع ذلك، فإن جغرافية منطقة الدراسة بعيدة عن المناطق الصحراوية، ولكنها تتأثر بالتغيرات البيئية العالمية، مثل معظم مناطق في العالم . تشهد مدينة أربيل ظاهرة العواصف الغبارية أو ترسب الغبارية ، ولقياس كمية ترسب الغبار في أربيل، تم استخدام سطح زجاجي خاص يبلغ طوله وعرضه مترًا واحدًا، مزودًا بالزجاج، لجمع جزيئات الغبار. تم إجراء تحليل علمي لترسب الغبار في عام ٢٠٢٤ وفقًا للنتائج، حيث بلغ الحد الأقصى لكمية ترسب الغبار المسجلة في مدينة أربيل ٣.٥ جرام في شهر سبتمبر، وتم تسجيل الحد الأدنى لترسب الغبار في شهر مايو ٢٠٢٤ وهو ١.٢ غرام، وتبلغ المساحة الإجمالية المقابلة لترسب الغبار في أربيل من عام ٢٠٢٤ حوالي ٣٨٣ كم2، ومتوسط ترسب الغبار لكل متر مربع في مدينة أربيل عام ٢٠٢٤يبلغ ٢٨.٢١ غرام، وإجمالي ترسب الغبار من مدينة أربيل في عام ٢٠٢٤: ١٠.٨ طن. ولمقارنة وتحليل البيانات الناتجة، تم استخدام نظام المعلومات الجغرافية (GIS).

الكلمات المفتاحية: التلوث، الغرام، المنطقة، الجغرافية، الترسيب.