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An Overview on Quantitative Variations, Spatial and Temporal Distribution and Physical Properties of Dust in Zahedan City, Zahedan, Iran

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ABSTRACT

As one of the most important atmospheric phenomena, dusthas received great deal of attentions by many researchers in various branches of science, including atmospheric science. Usually, particles of dust have a diameter of less than 100 microns, which deposit on earth surface having been transmitted horizontally or vertically in several miles. The purpose of this study was to determine the weight and volume of waste dust in Zahedan, studying the quantitative changes and the distribution of the spatial concentration of dust to verify the urban pollution to dust particles. The collected dust samples were collected for a period of six months from January 2014 to June 2014, and a total of 180 samples were collected from different areas of the city. Sampling was done using mild sediment trap. Statistical analysis showed that during the sampling period, the highest amount of landfill loss was observed in March with a mean of 5.9 ± 5.11 grams per square meter and the lowest was in February, with a mean of 1.31 ± 0.65 grams' Square meter. The results showed that the volume and average amount of dust loss in winter was 233.88 m3 and 9.625 gr / m2, respectively. The values for the spring are 166.66 m3 and 6.319 gr / m respectively. The results of the comparison of the mean loss rate of dust with the use of t-test showed that the difference between the mean dust loss rates between winter and spring was significant (P-value = 0.03) and the rate of dust loss in winter is more than spring. The zoning of dust in the chapters of the study showed that the spatial distribution of dust in the winter is a regular pattern indicating the origin of dusty urban outbreaks in this season, while the presence of irregularities in the spatial variation of dust in the spring indicates the origin inside the city dust is in the spring.

Keywords: *Dust, Heavy Metals, Pollution, Zahedan.*

INTRODUCTION

For decades, contamination and environmental degradation have been one of the most important and worrying issues at the national, regional and international levels. One of the contaminations that has been mentioned as an important dilemma in recent decades is the dust phenomenon (Eckhoff, 2009; Xie et al., 2010). Dust is usually a mixture of solids or dissolved particles, or both, which are suspended in the air and are able to remain suspended for a long time, even a few kilometers away from their original source, along with a series.

Discharged from the mineral particles into the atmosphere will increase the concentration of some other pollutants, including heavy metals, and cause harmful effects on humans and other organisms (Sheikhi et al., 2010). More recently, increased dust has caused serious problems, especially in areas close to dry areas (Nakano et al., 2004). The dry and semi-arid Asia is one of the most important hot spots in the world. Among the dust-affected areas, the Middle East is one of the world's most dust-stricken areas and is very vulnerable due to the presence of dry and dry desert belts (Lashkar and Kaykhsrovi, 2008). Studies in relation to the frequency of dusty days in the country show that the central holes in Iran have the highest number of dust days (Alijani, 1997). Also, most of the cities located in arid and semi-arid regions of Iran are the most important source Natural air pollution is dust (Soltani and mabani, 2005).

Creating dust can be a response to the change in land cover, in which the role of human activities, along with the natural environment of the geographic environment, should not be neglected (Ebadat, 2010). Dust is one of the important components of air pollutants that are either directly or indirectly referred to as "primary particles" through erosion of the internal or external source, including natural and man-made activities such as: vehicles, industrial, domestic, The erosion of non-asphalt and fire roads enters the environment or, after entering the environment, by reaction with several compounds such as SO2 (sulfur dioxide) and NOx (nitrogen oxides), which are mostly caused by combustion of fossil fuels, industries and traffic to the environment. Are released, they form in the form of secondary particles (aerosols). In areas with high soil erosion, dust as a major contaminant reduces air quality and endangers human health (Tabatabaei et al., 2014). Littering mist 3 means dust that falls from the atmosphere on the surface of the earth, which can indirectly be investigated by contamination of all suspended particles (Hai et al., 2008). Litter dust is hazardous to human health and the environment. It has a negative impact on many industrial products and activities (Goossens& Buck, 2009). In general, two types of contaminants were detected in dust: the first species consisted of CO, NO2, SO2, heavy metals, especially lead and cadmium, and the second, containing the chemical, physical and biological components of dust (IreneRodriguez et al. 2009). Dust is one of the atmospheric phenomena that has adverse environmental effects and impacts. Dust causes climate change on a global and local scale, a change in the biological, geological, chemical or environmental environment of humans. Mineral particles from dust can affect cloud formation, cloud characteristics, and atmospheric deposition, atmospheric dust prevents sunlight penetration and can lead to a decline in agricultural production by -30 to 5 percent (Shahasooni, 2010). Considering the importance of the dust phenomenon and its effect on the atmosphere, temperature, climate, rainfall, drought and its ability to transport metals, pesticides, radioactive materials and organisms such as bacteria and viruses, and as a result Their entry into the respiratory system and the harmful effects on the health of humans and other creatures, the importance of the issue becomes more apparent (raygani, 2012). In the course of the research, the lava dust in Kerman analyzed the spatial, temporal and meteorological parameters and concluded that temperature, humidity and wind speed do not have much effect on the concentration of dust, but there is a significant relationship between precipitation and dust concentration (Malakootian et al. 2013).

Physical and chemical changes of dust particles along the transect between the center of Iran and the Zagros Mountains in the west were investigated. The results showed that the rate of deposition, the average particle size and the concentration of soluble ions with the height decreases (Hojati et al., 2012) . Whether the weight and volume of the dust in the city of Zahedan have time or spatial changes has not been thoroughly investigated. Due to the fact that in the arid and semi-arid regions of the country the main cause of air pollution is dust and it is considered as one of the most harmful pollutants for human health, the present study aims to investigate spatial and temporal changes and physical properties of dust Loss of the city of Zahedan.

MATERIALS AND METHODS

Introducing the Study Area

The city of Zahedan, with a height of 2006 meters above sea level, has hot and dry air and is very hot during the summer, and the temperature is noticeably reduced at night. 120-day winds of Sistan indirectly affect the temperature of Zahedan city (Sistan and Baluchestan portal, 2006).

Research Methodology

In this research, random sampling method was used to determine the sampling points. Thus, 30 stations were selected in the city. Mildew Trap (MDCO) was used to investigate the loss of dust. The sampler was placed at a height of 1.5 meters from the back of the floor. The sample container was a circular shape to minimize the effect of wind direction. The standard glass balls used were 1.6 cm in diameter. Sampling of mist was carried out during the winter season of 2014 and spring of 2015. Samples were sampled on a monthly basis. A total of 180 dust samples were taken from 30 stations in the city. At the same time as each sample was taken, the geographic coordinates of each point were memorized using GPS in the UTM system. During this period, 6 months of trapped mist trapped in sediment traps were carefully collected on a monthly basis and weighed accurately using a scale of 0.001 g. After the dust was sampled and transferred to the laboratory, the amount of dust was weighed separately for each chapter. It was then dried for 4 minutes by a shaker consisting of 4000, 2000, 1000, 500, 250, 125, 63 and 32 microns in eight grades. In the next step, the dust weight was recorded in each of the eclipses. Using GR graf 3.0 software, mid-diameter indices, sorting, skewness, curvature and histogram, percentage of seeding frequency and distribution table were obtained. One-way ANOVA was used to study the variation of dust in different sampling locations for winter and spring.

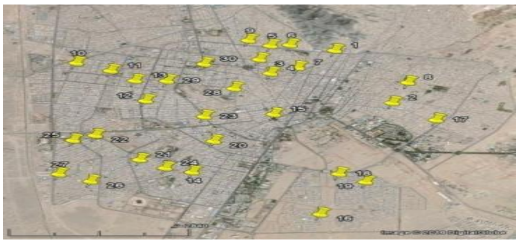


Fig1. *Sample station position on Google Earth*

How to Check Spatial and Seasonal Changes Through the Pitch Statistics

Investigating the spatial structure of the variables studied in this research was carried out in two steps:

1- Recognition and modeling of the spatial pattern of the studied variables, including scattering dust (weight per unit area and dust height)

2- Determine the most suitable statistical method of landing the variable quantity by conventional Kriging method and its zoning

In the first stage, after the information file was prepared, the variables of the dropping dust and the volume of those statistical indicators of the classical dust data were investigated and the input file of ArcGIS 9.3 software was prepared. At the end, by performing routine validation operations, the mean standard error and the coefficient of determination, the accuracy of the map was calculated. To determine the amount of dust on the surface of the city, after providing the dust mist's zoning map in meters, the Volume option was used in the Arc GIS software. With average density of dust (ton / m31 / 1) and the obtained volume, the average weight of dust was measured in the city.

Results

The Classic Drop-down Statistics

The average weighted average of the dust collected per unit area from 30 sampling stations in the months of May to June is given in the table below.

Table1. *Classical drop-down statistics during the sampling period*

Littering mist per month (g / m2)						Statistical variable
June	**may**	**April**	**March**	**feb**	**January**	
1.87	1.84	1.56	5.11	1.33	1.33	Average arithmetic (gr / m2)
1.04	0.55	0.67	5.69	0.65	0.34	Standard deviation
1.000	1.001	1.025	1.011	1.007	1.000	At least
5.340	3.410	4.432	18.031	3.613	2.705	Maximum
1.01	2.98	1.47	3.12	2.29	0.34	Skidding
7.12	1.16	11.29	0.54	9.10	7.45	Elongation
0.000	0.28	0.10	0.000	0.000	0.38	K-S

According to the Kolmogorov-Smirnov test, the data for February, March and June were abnormal, which was normalized by the logarithm of the base 10. As can be seen from the results (Table 1), the average weight of dust loss in February is less than the other months and is most pronounced in March.One-way analysis of variance (ANOVA) was used to determine the temporal and spatial differences in the amount of waste dust.

The results of this test for the two seasons of winter and spring are described in Tables (2) and (3):

Table2. The results of the analysis of variance of lumps dust between months and different locations in winter

Place					time					Sources Change
Meaningfulness	F	average of squares	sum of squares	Degrees of freedom	Meaningfulness	F	average of squares	sum of squares	Degrees of freedom	
ns0.8	0.749	11.414	331.015	29	0.000	13.094	144.011	288.021	2	Month
		15.231	913.876	60			10.999	956.780	78	Error
			1244.891	89				1244.891	89	Total

ns: No significant difference

The results of the analysis of variance for winter (Table 2) showed that there is a significant difference between different months (P-value = 0/000), while there is no significant difference between the stations (P -value =).

However, the results of the test of variance analysis of fall mist in spring (Table 3) showed that the difference between months and stations in spring is not significant.

Table3. *The results of the analysis of the variance of lavatory dust between the months and different locations in the spring*

Place					time					Sources Change
Meaningfulness	F	average of squares	sum of squares	Degrees of freedom	Meaningfulness	F	average of squares	sum of squares	Degrees of freedom	
s0.62	0.891	0.575	16.661	29	ns0.25	1.384	0.853	1.706	2	Month
		0.645	38.680	60			0.616	53.635	78	Error
			55.341	89				55.341	89	Total

ns: No significant difference

Comparison of the average effect of the season on the mist

To compare the mean loss of dust in the two seasons studied, after normalizing the data, a t-coupled test was used. The results of the t-test between two seasons of winter and spring showed that there was a significant difference in the amount of dust in the level of 5% (P-value = 0.03), (Table 4). Also, the results indicate that the mean dust Loss in winter changes at a range of 588.2 ± 1 950 g / m2.

Meanwhile, the average dust loss in the spring was measured at a range of 1,761 ± 0.477 g / m2, which means that the dust loss rate in winter is higher than in the spring.

Table4. *T-test of coupled data of winter and spring dust*

	Average arithmetic (gr / m2)	Standard deviation	The upper limit is the confidence interval	Lower limit of confidence interval	t	Degrees of freedom	P-value
Dust	0.82	2.03	1.58	0.06	2/22	29	0.03

To calculate the dust volume, 9.3 Arc GIS software was used. The volumes and volumes of volatile dust are given in (Table 5).

Comparison of the average volume of dust showed that the amount of dust in the winter is more than spring.

Table5. *The average weight and volume of dust in two seasons*

Spring	winter	Parameter
166.69	253.88	Loss of dust (m3)
6.319	9.625	Average weights of dust (gr / m2)
158.495	232.971	Cumulative Weight of Litter Mist (gr / m2)

Investigation of Spot Distribution of Litter Mist from Land View

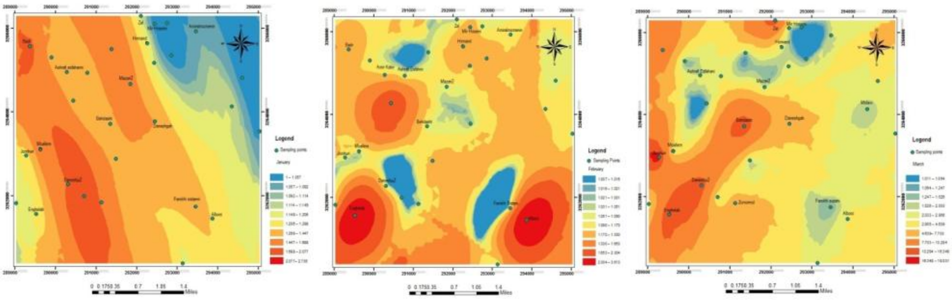
Scattering of dust in the winter months

Land statistics were used to zon the distribution of scattering dust in Zahedan.After analyzing and normalizing the data, various methods such as inverted distance, kriging, radial function, natural neighborhood and weighted moving average were used. Finally, the Kriging method was used due to lower RMSE for zoning. Took (Table 6).

Table6. *RMSE values for different zoning methods*

Weighted moving average	Natural Neighborhood	Radial function	Kriging	Reverse the distance
0.34	0.34	0.33	0.33	0.33

According to (Fig. 2), the highest concentration of dusts in the range of 1.68 to 2.07 g /m^2 is located on the south side. Maximum dust concentration in February with a range of 2.304-3.613 g /m^2 is observed as spots on two sides of the southeast and southwest. Distribution of dust in March with a range of 7.703-18.031 g /m^2 stretches from the southwest to the northwest.

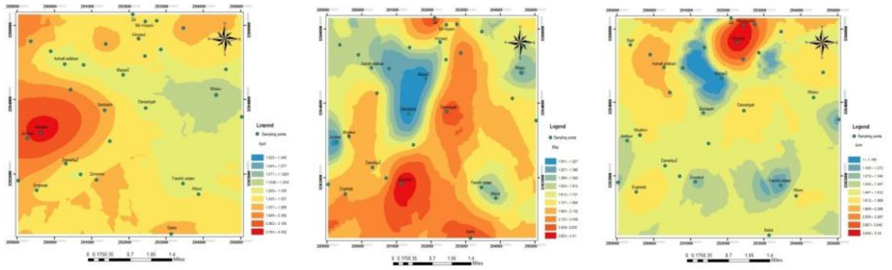


(a) (b) (c)

Fig2. *The Kriging map of the spatial distribution of desiccant dust in winter. a) January B) Feb. C) March*

Scattering of dust in the spring months

The spatial distributions of dust in the spring (Fig.3) show that the maximum concentration of dust in April, May and June was 1.856-4.432, 2.852-3.41 and 2.887 -5.34 g /m^2, respectively, located on the western side, south and north



(a) (b) (c)

Fig3. *The Kriging map the spatial distribution of the mist falls in the spring of a) April; b) May; c) June*

Investigation of dust concentration in two seasons studied

The study of the zoning pattern of lava dust in winter showed that in the major part of the city, the amount of dust was moderate and in the stations of the student 2, the republic, the revolution, the health and Zal the amount of litter was high (Fig. 4). According to the seasonal zoning map, the amount of mist at the stations of Teacher, Hirmand and Mir Hosseini is more than other stations.

The amount of less mist was measured at Mazar 2, Farrokhi Sistani and Ashrafi Esfahani stations (Fig. 5).

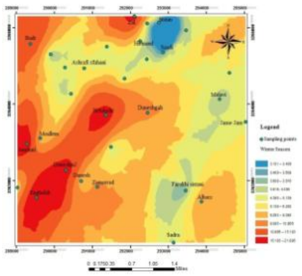


Fig4. *Landing dust marshland map winter 2014*

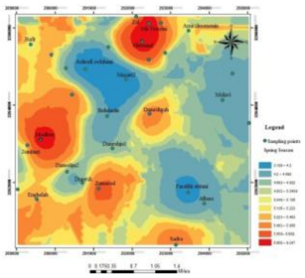


Fig5. *Landing Dust Mapping Schedule Spring 2015*

Investigating the physical properties of the mist

Grain Mist Winter

Laying dust in the winter season revealed that the average diameter of the dust particles in this season is very fine sand, is well-matched, and is symmetrical skewness.

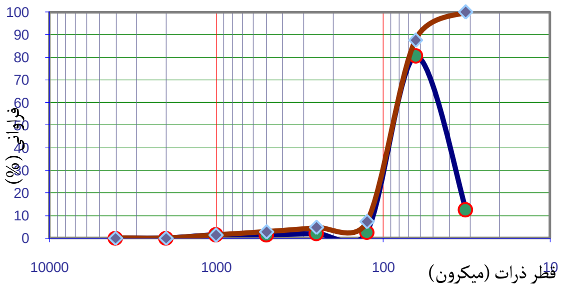


Fig6. Characteristics of the percentage of dust particles diameter in winter

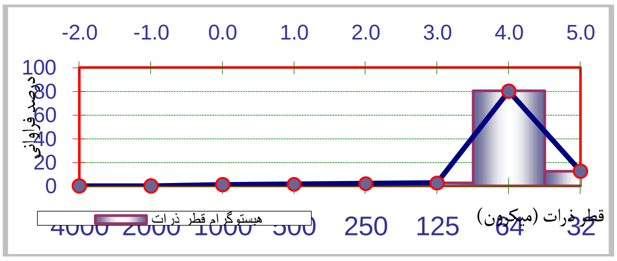


Fig7. *Histogram and curve Percentage of the frequency of dust particles in winter*

(Table 7) shows that the seeds with the diameter of 4000 and 2000 microns are the lowest and the seeds with a diameter of 63 microns have the highest weight percentages.

Table7. *Distribution of dust distribution in winter*

Grain diameter (micron)	Weight (g)	Percentages	The cumulative percentage
4000	0	0	0
2000	0	0	0
1000	1.22	1.33	1.33
500	1.30	1.41	2.74
250	1.79	1.95	4.69
125	2.35	2.56	7.25
63	73.94	80.38	87.63
32	11.38	12.37	100.00

Grit Mist Spring

The separation of the dust of the spring showed that the middle diameter of the particles was very fine sand, slightly tightly sorted to the coarse grain particles. The tiny particle sorter this month suggests a lack of uniform particle size.

The chalk to the fact that the dust particles in this chapter show the normal distribution of grains.

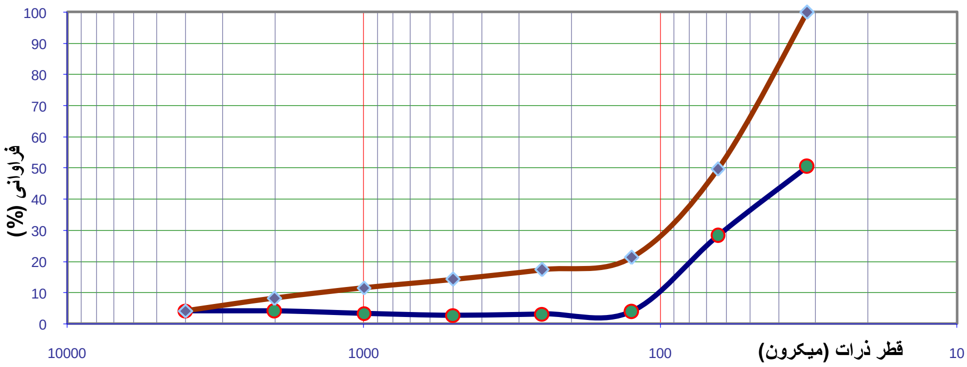


Fig8. *Characteristics of the percentage of dust particles in the spring*

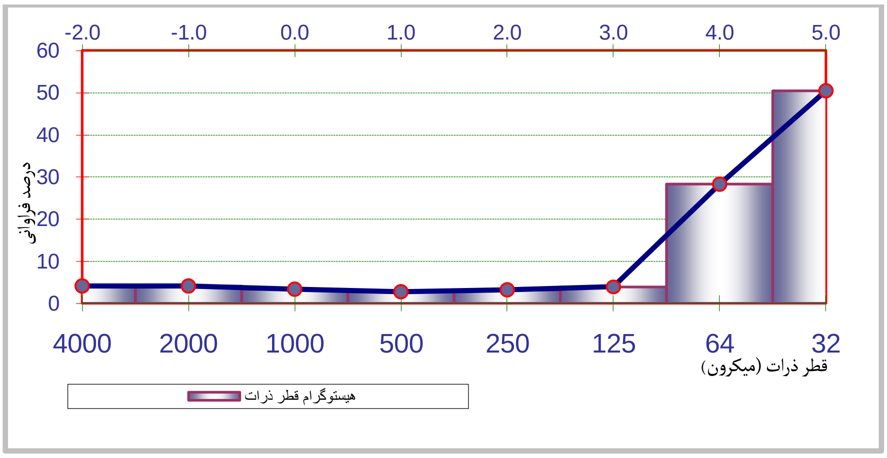


Fig9. *Histogram and Curve Percentage Frequency of Dust Particle Separation in Spring*

(Table 8) shows that the seeds with a diameter of 500 microns are the smallest, and the seeds with the diameter of 32 microns' account for the highest percentage.

Table8. *Distribution Table of Dust in the Spring*

Grain diameter (micron)	Weight (g)	Percentages	The cumulative percentage
4000	2.83	4.14	4.14
2000	2.79	4.08	8.22
1000	2.28	3.33	11.55
500	1.86	2.73	14.28
250	2.15	3.14	17.42
125	2.65	3.88	21.30
63	19.39	28.30	49.60
32	34.55	50.40	100

Discussion and Conclusion

Landing dust marshalling maps of winter and spring indicate that the average amount of winter dust loss is higher than spring. The reason for this is the severe storms with southern origin in February and March 2014 that affected the city of Zahedan. To be more precise, it is a weighted average area, so that a more accurate analysis of the status of the dust can be found. The existence of spatial and temporal differences in the mist of dust in different cities and in different months in the reports (Akbari et al., 2011) in Behbahan city (Ismailzadeh et al., 2013) in Yazd and (Health, 2013) in Isfahan It has been reported that in all of these reports, the amount of landfill dust in the spring and winter seasons has a spatial and temporal difference that is consistent with the results of this study. According to the total results, it was found that the weight and volume of the dust in different months of winter and spring have spatial and temporal changes. The spatial and temporal changes in dust can be caused due to the low green space, especially in the direction of wind blowing, developmental activities and 120-day winds of Sistan, and the difference in urban density and urban marginal topographic complications.

The pattern of dust accumulation in winter (Figure 4) and spring (Figure 5) shows that the center of production of dust in the city is related to the north and west, and the spatial distribution of dust in the winter season is a regular pattern. It confirms the role of the outsourcing of dust in the winter. On the other hand, the presence of irregularities in the process of spatial variations of dust in the spring indicates the origin of urban dust in this season.

Suggestions

In this study, we tried to evaluate the weight and volume of landfill in Zahedan during winter and spring. Some physical properties, including the grain-setting of dust particles, were determined. In this study, dust situation in Zahedan during the months of June to June was investigated. It is suggested that the dust in the city of Zahedan be investigated in the summer and autumn, in order to determine the time of dust.

According to the results of this study, it is suggested that the source of dust in Zahedan be determined to determine if the source is effective in the amount of dust in the city or the dust of neighboring countries causes it.

Part of the misty dust of the city of Zahedan is of an urban origin. Since part of this amount is related to the drying of Lake Hamoon, wind erosion control in these areas can be effective in reducing the desertification of the city of Zahedan. In this study, the desertification of the city of Zahedan was investigated using mild sediment trap. It is suggested that, with other samples of dust, the amount of dust in the city of Zahedan should be investigated. It is recommended to check the effect of building height on the amount of dust in the wind direction.

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NOTES

- Dust
- Aerosol
- Dust falling
- Marble Dust Collector
- Geostatistics
- Inverse Distance Weighting
- Ordinary Kriging
- Radial Basis Functions
- Natural Neighbor

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