Produce an Analytical Map for the Distribution of Air Pollution by Toxic Gases in Baghdad City by Geographic Information System

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Abstract

Iraq suffers from pollution of the air with many gases, such as carbon dioxide, carbon monoxide, methane, ozone and others. Baghdad governorate was used as an example to measure the amount of air pollution and distribution in the areas of Baghdad and used data for three measurement stations in Baghdad is the station Jadiriya, Andulos and Alwaziriya, which are available only and for three gases are carbon dioxide and carbon monoxide and ozone and 2011 and 2012 and for all months. The study used three methods of mathematical induction (IDW, Kriging and Spline), one of the methods of mathematical induction in GIS programs. Analytical maps of the distribution and distribution of gases were obtained in Baghdad and it became clear that the IDW method is the most accurate of the three methods.   [DOI: 10.22401/JNUS.21.2.12]

1. Introduction

The atmosphere consists of three layers: troposphere, stratosphere, ionosphere, And human activities in the first layer where air changes occur. The air is composed of non-polluted air Nitrogen, oxygen and argon with known and specific concentrations do not dissolve for a few concentrations of biodiesel Carbon, neon, helium, hydrogen and water vapor. The expression of air pollution indicates the presence of substances in the air Different concentrations harmful to human health, animals and plants and damage to the environment and soil Sources of these pollutants It may be natural that a person did not cause it or was abnormal. The person caused it as its use Fuel in the industry, transportation, radioactivity and pollution have significant impacts from place to place[1].

Around 2.4 million people die every year due to some reasons attributed to air pollution due to its impact on the hole of Ozone and acid rain. on the one hand. On the other hand, some means of control can be used for handling the Air pollution generated by industry and transportation such as mechanical complexes and electrostatic precipitation filters, gas washing machines and more as listed in table (1) .[2].

Table (1)
Indicative values of independent substances in the air based on non-cancerous effects, odor and disturbance [2].

Subject	Guided Values	Time for exposure
CO	100 mg/m3	15 minute
CO2	0.4 mg/m3	60 minute
O3	0.15 – 0.20 mg/m3	60 minute

1.1 Carbon monoxide (CO)

It is a gas that has no color or odor; and is the result of incomplete combustion of fuel. It is issued from exhausted Cars are burning coal or firewood in heaters. It is the most dangerous type of air pollution and the most toxic to Human and animal. crystalline carbon monoxide with hemoglobin is a component of carboxylic hemoglobin and thus inhibits Oxygen from the union with hemoglobin in this case deprives the body of oxygen [3].

1.2 Carbon dioxide(CO2)

Increasing its concentration leads to difficulty breathing and feeling congested with irritation of mucous membranes and bronchitis Aerobic and throat irritation. Carbon dioxide is made up of organic materials such as paper, wood, coal and oil.

Carbon dioxide is one of the most important contaminants that humans have put into the air. The process of environmental

equilibrium that dissolves excess carbon dioxide in the sea and ocean waters is acidic Is known as carbonic acid and reacts with some sediments consisting of bicarbonate and calcium carbonate. Plants also contribute much of it to photosynthesis.

It should be noted that excessive use of fuel, cutting forests or reducing green spaces contributed to the rise in carbon dioxide in the atmosphere which could lead to global warming which is known as global warming. [4]

1.3 Damage to air pollution on the ozone layer

A poisonous, transparent gas that blurs into blue; and its molecule consists of three oxygen atoms. Ozone is present in the lower troposphere and the stratosphere. Ozone is formed in the lower atmosphere of pollutants from transport or some vehicles Which contain hydrocarbons. In this case, ozone is a dangerous component on human health because breathing a small amount of it causes irritation in the respiratory system and death may occur. Ozone in the upper atmosphere consists of the interaction of oxygen molecules with free oxygen The resulting fission of these particles results from ultraviolet radiation:

$$O_2 + O \text{ ultra violet} \rightarrow O_3$$
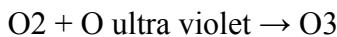
2. Study area

In this research, the city of Baghdad was chosen due to the high population density, due to the presence of many causes of air pollutants such as factories, laboratories and cars. Using the Google Earth program, a image of the city of Baghdad is taken and the three meteorological stations are projection, as shown Fig.(1).
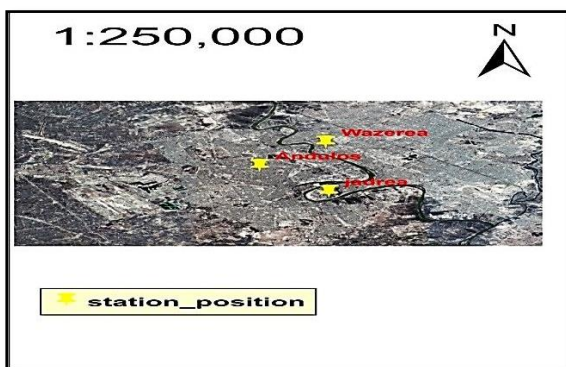
Fig.(1): Show Baghdad image and three meteorological station.

3. Research problem

The research attempts to find an analytical map for the distribution of air polluting gases in the city of Baghdad.

Techniques used in research

In this research, the use of GIS techniques, which are modern technologies and high efficiency. The (ARCMAP 10.2) program is the latest version are used in the research.

Data used in the search

Monthly data for the time interval 2011 and 2012 and for three monitoring stations in Baghdad was used; they listed in Table (2).

Table (2)
Data for air quality control stations in Baghdad for 2011 and 2012 [5].

SO2	O3	CO	Date & Time
Al Jadiria JAN -2011			
SO2	O3	CO	Date & Time
ppm	ppm	ppm	
0.045	0.092	0.855	January
0.032	0.099	0.615	February
0.026	0.112	0.527	March
0.048	0.046	0.435	April
0.042	0.044	0.452	May
0.045	0.066	0.523	June
0.056	0.047	0.61	July
0.043	0.077	0.61	August
0.044	0.081	0.671	September
0.049	0.081	0.918	October
0.037	0.068	0.726	November
0.055	0.056	0.997	December
0.0435	0.072	0.661	The average
Al Waziria JAN -2011			
SO2	O3	CO	Date & Time
ppm	ppm	ppm	
0.03	0.011	0.903	January
0.026	0.021	0.661	February
0.023	0.038	0.773	March
0.025	0.035	0.871	April
0.04	0.034	0.787	May
0.052	0.034	0.64	June
0.041	0.031	0.739	July
0.048	0.022	0.552	August
0.054	0.025	0.665	September
0.059	0.022	0.917	October
0.041	0.015	0.952	November
0.047	0.01	1.255	December
0.040	0.024	0.809	The average
Al Andlus JAN -2011			
SO2	O3	CO	Date & Time
ppm	ppm	ppm	
0.034	0.023	0.818	June
0.037	0.021	1.21	July
0.033	0.015	1.046	August
0.038	0.02	1.222	September
0.034	0.021	1.061	October
0.033	0.01	1.156	November
0.038	0.007	1.527	December
0.035	0.016	1.148	The average
Al Jadiria JAN -2012			
SO2	O3	CO	Date & Time
ppm	ppm	ppm	
0.05	0.06	0.928	January

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SO2	O3	CO	Date & Time
0.036	0.05	0.653	February
0.041	0.037	0.493	March
0.032	0.047	0.447	April
0.048	0.034	0.436	May
0.051	0.03	0.496	June
0.049	0.042	0.705	July
0.013	0.05	0.524	August
0.014	0.062	0.57	September
0.01	0.051	0.54	October
0.021	0.047	0.937	November
0.036	0.043	0.898	December
0.033	0.046	0.635	The average
Al Waziria JAN -2012			
SO2	O3	CO	Date & Time
ppm	ppm	ppm	
0.053	0.011	1.495	January
0.046	0.21	1.148	February
0.032	0.03	0.939	March
0.031	0.032	0.746	April
0.014	0.035	0.669	May
0.026	0.039	0.549	June
0.047	0.036	0.815	July
0.043	0.027	0.826	August
0.036	0.03	0.792	September
0.039	0.018	0.935	October
0.022	0.013	1.086	November
0.035	0.006	1.241	December
0.035	0.040	0.936	The average
Al Andlus JAN -2012			
SO2	O3	CO	Date & Time
ppm	ppm	ppm	
0.05	0.013	1.418	January
0.034	0.019	0.729	February
0.028	0.028	0.655	March
0.025	0.034	0.607	April
0.021	0.031	0.592	May
0.033	0.03	0.86	June
0.046	0.039	0.945	July
0.048	0.021	0.947	August
0.046	0.024	0.937	September
0.049	0.021	0.862	October
0.038	0.02	0.989	November
0.05	0.013	0.972	December
0.039	0.0244	0.876	The average

Splining

In the mathematical field of numerical analysis, spline interpolation is a form of interpolation where the interpolation is a special type of piecewise polynomial called a spline. Spline interpolation is preferred over polynomial interpolation because the interpolation error can be made even when using low degree polynomials for the spline.

Inverse Distance Weighted Average (IDW)

- Each input point has local influence that diminishes with distance.
- Estimates are the averages of values at n known points within window.

The linear spline interpolation is: [6]

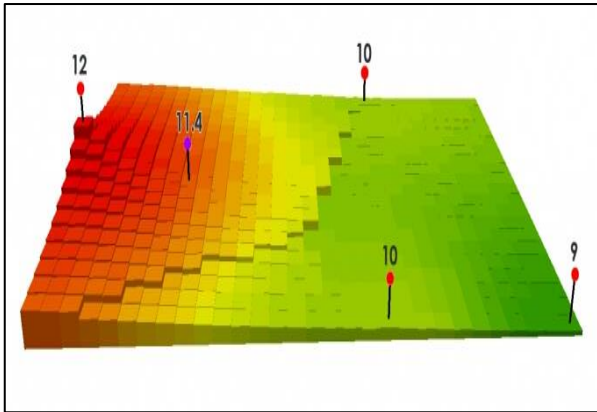$$S_i(x) = y_i + \frac{y_{i+1} - y_i}{x_{i+1} - x_i}(x - x_i)$$

Fig.(2): Show the IDW method [7].

Kriging

Kriging is an advanced geostatistical procedure that generates an estimated surface from a scattered set of points with z-values. Unlike other interpolation methods supported by ArcGIS Spatial Analyst, to use the Kriging tool effectively involves an interactive investigation of the spatial behavior of the phenomenon represented by the z-values before you select the best estimation method for generating the output surface.

4. Analysis methods :-

Three methods of interpolation were used in this study (IDW, Kriging, and Spline) in ArcGIS 10.2 program. as in Figs. (3,4,5,6,7,8).
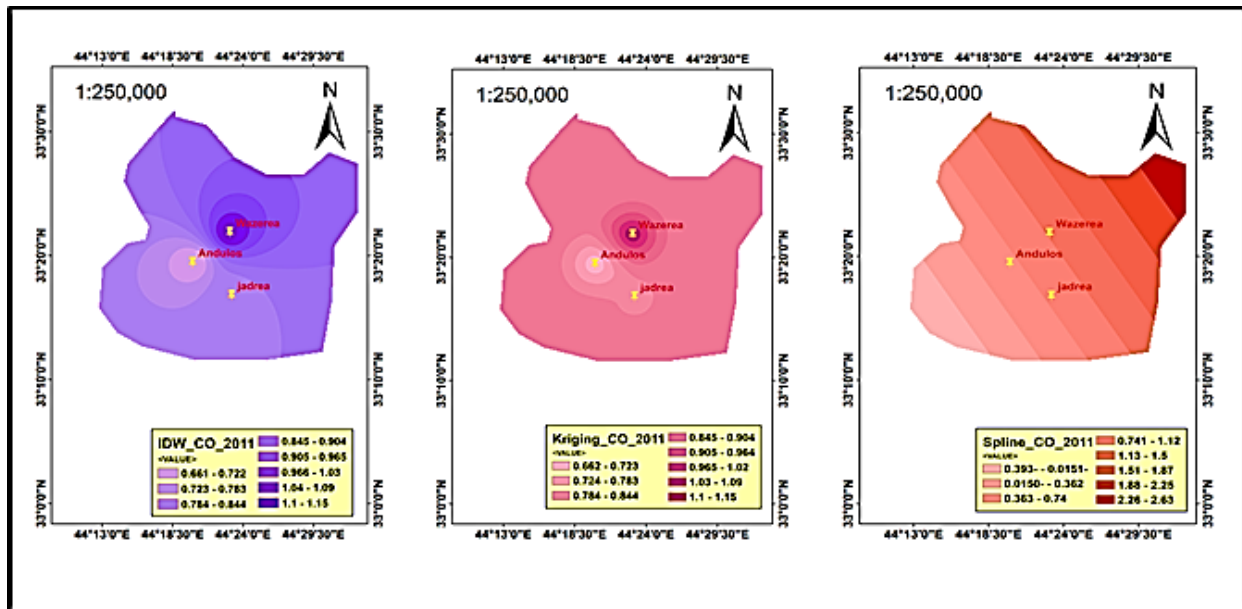

Fig.(3): Show three maps for the distribution of (CO) air pollution in the city of Baghdad in 2011 and using three methods of mathematical interpolation (IDW, Kriging and Spline).
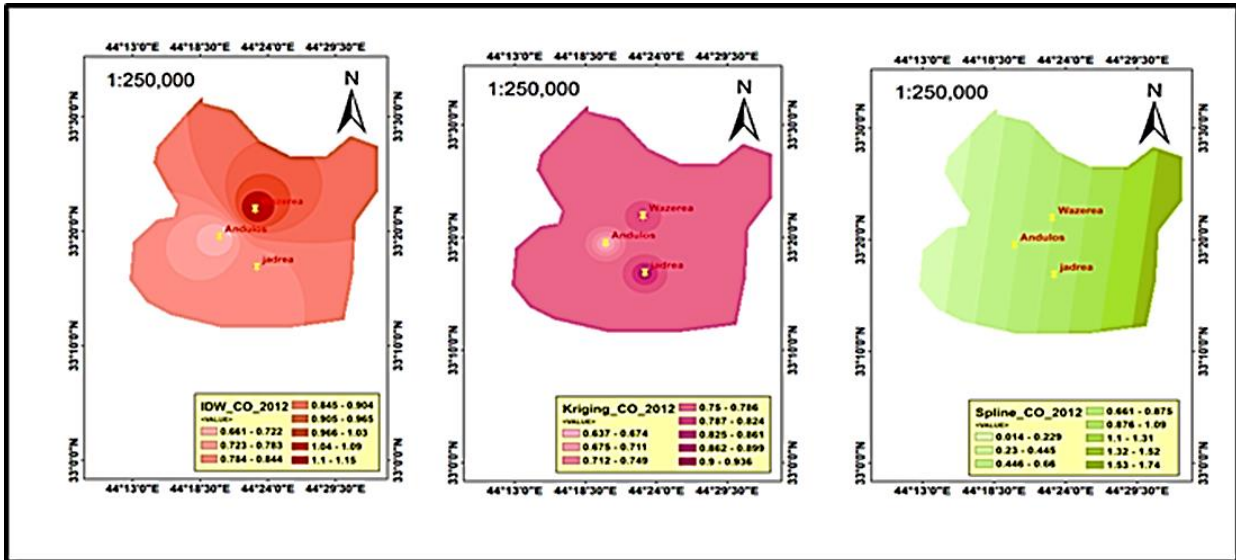
Fig.(4): *Show three maps for the distribution of (CO) air pollution in the city of Baghdad in 2012 and using three methods of mathematical interpolation (IDW, Kriging and Spline).*
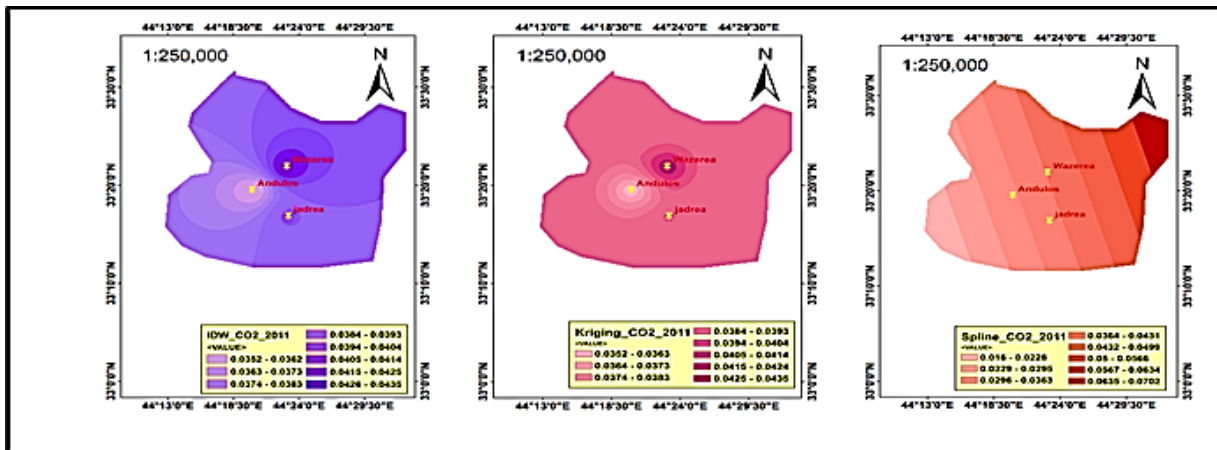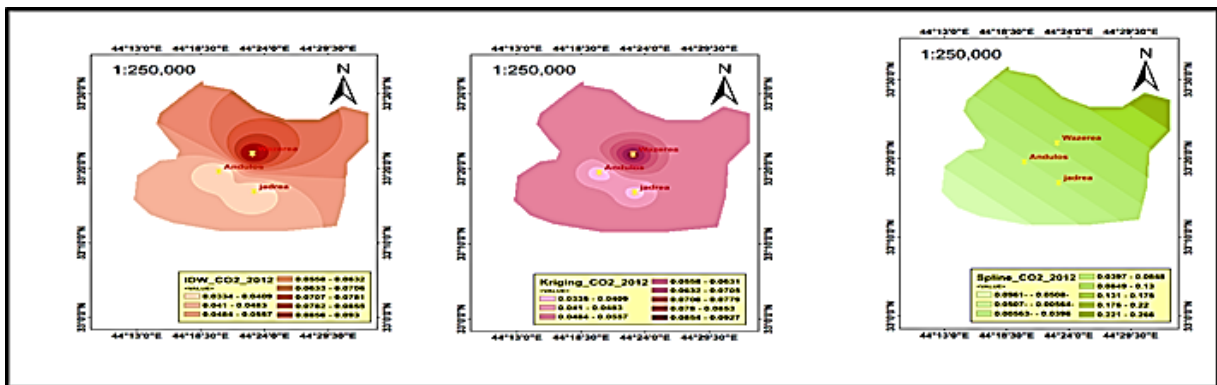

Fig.(5): *Show three maps for the distribution of (CO2) air pollution in the city of Baghdad in 2011 and using three methods of mathematical interpolation (IDW, Kriging and Spline).*

Fig.(6): *Show three maps for the distribution of (CO2) air pollution in the city of Baghdad in 2012 and using three methods of mathematical interpolation (IDW, Kriging and Spline).*
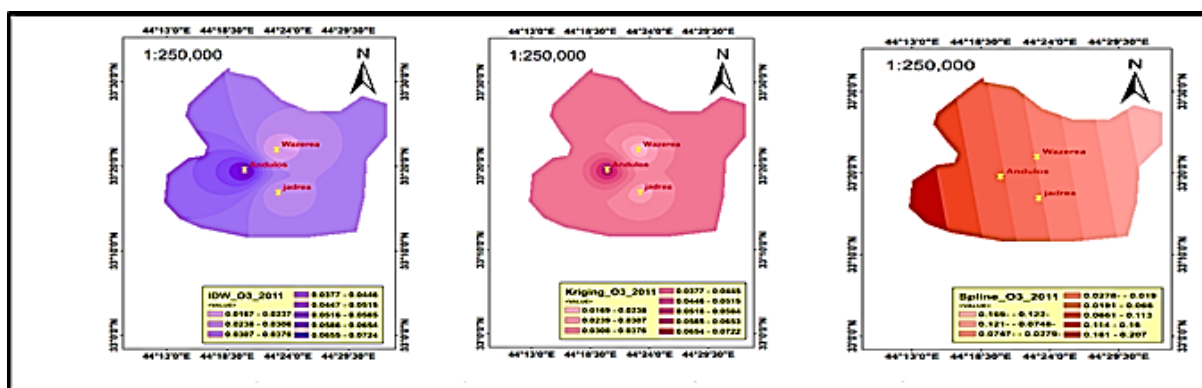
Fig.(7): Show three maps for the distribution of (O3) air pollution in the city of Baghdad in 2011 and using three methods of mathematical interpolation (IDW, Kriging and Spline).
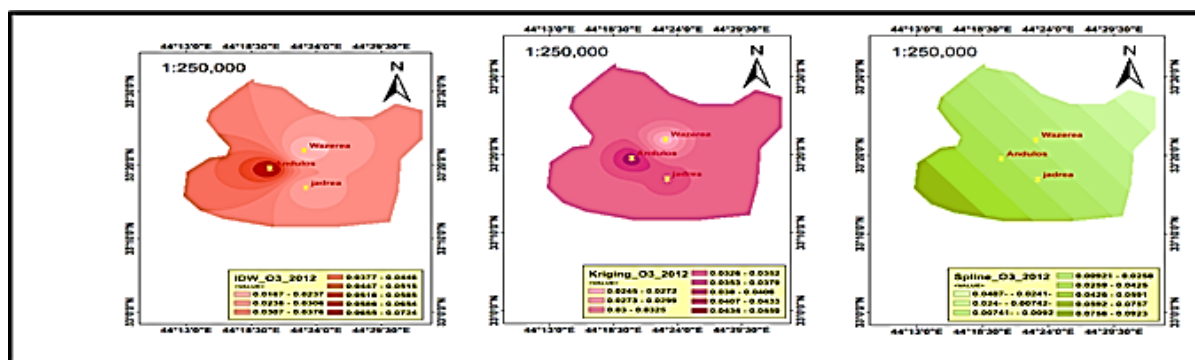

Fig.(8): Show three maps for the distribution of (O3) air pollution in the city of Baghdad in 2012 and using three methods of mathematical interpolation (IDW, Kriging and Spline).

5. Conclusion

From the present work, the data measurement for (CO, CO_2, O_3) concentrated we conclude that:

1. The IDW method is the most accurate of the three interpolation methods.
2. Carbon monoxide (CO) is concentrated in the northeastern part of Baghdad (Rusafa district).
3. Carbon dioxide (CO_2) is concentrated in the northeastern part of Baghdad (Rusafa district).
4. While ozone (O_3) is concentrated in the south-eastern part of Baghdad (Karkh district).

6. Recommendations

1. Increase the number of monitoring stations in Baghdad because their number is small compared to "the size of the city and the population.
2. The need to reduce the value of air pollution in the first gases and carbon dioxide in Baghdad, especially the north-eastern part of them.
3. Plant many trees because they have a significant effect on the absorption of the first and second carbon dioxide and increase oxygen.
4. Minimize and prevent the release and release of harmful compounds such as chlorofluorocarbons and halons as these compounds are the most harmful source to the ozone layer.

References

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