INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

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PREPARE MAPS OF OZONE POLLUTION IN BAGHDAD CITY USING ARC – GIS TECHNIQUES

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ABSTRACT
The layer surrounding the earth's surface is the troposphere. Here, ground-level or "bad" ozone is an air pollutant that damages human health, vegetation, and many common materials. This study was carried out the ozone pollution in Baghdad city and determined the distribution of it by using data collection in 14^{th} in March 2016. The ozone concentration ranges from 115 ppb 11 ppb. In this study, the general and dujustive Kriging techniques of interpolation applied for Ozone concentration. To decide the dependability of the maps estimate, likelihood and standard errors are calculated using Gaussian geostatistical simulation. Analytical determination and classification of air pollutant concentration of Ozone in Baghdad city was analysed. The experimental data analysis, semi variogram and variogram models appropriate, and generation air pollution of ozone concentration and estimate maps in Baghdad are expert through use of ArcGIS software. This program was used to prepare distribution maps of ozone pollution in Baghdad city. Color gradients are used to indicate pollutants concentrations dispersion in the study area.

KEY WORDS: Spatial interpolation; surface temperature; inverse distance weighting; ordinary kriging.

INTRODUCTION

The need for spatial interpolation models in the monitoring environment has grown in the past few years. The EPA is using these models to review choices on monitoring network design and to calculate the efficacy of release control programs. Due to the limited number of monitoring sites across the country for ambient concentrations of ozone and fine particles, there is a necessity to use spatial interpolation to predict ambient concentrations in unmonitored locations. Support for these methods has occurred from researchers and state/ local/ EPA agencies in recent workshops[1]. The general consent is that it is now probable to model the spatial requirement of air pollution data to reliably predict concentrations in unmonitored locations along with associated uncertainties for use in developing regulatory policy[2]. EPA recognizes the merits of these methods, more specifically kriging, for use in the modeled attainment tests for the 8-hour ozone and PM 2.5 National Ambient Air Quality Standards attainment emonstrations. These methods provide environmental decision makers the opportunity to show important gradients of air pollution, review the location of monitoring networks and refine the definition of nonattainment boundaries [1,2].

Spatial addition investigation had been isolated into two procedures. To start with, non-geostatistical approximated values utilizing scientific conditions to figure the obscure focuses from known focuses. It was incorporated assortment of techniques, for example, closest neighbors, IDW, incline surface investigation, spline and so on. Second, geostatistical utilizing insights to decide the attainability of value for introduce in light of a spatial relationship[2]. Kriging was an introduction technique in view of the variety between focuses however was not weighted by the separation between known focuses and obscure focuses. Gathering of indicate concurring spatial connections are entwined in every point. At that point, we found that the inconstancy to be utilized as weighted esteem, for example, OK, widespread kriging, cokriging and so on. Be that as it may, spatial interjection whole region while the neighborhood property gauges values in zone of intrigued. Second, the correct quality inserts through all focuses. In this way, the deliberate qualities are roughly equivalent. The inaccurate characteristic through not all focuses it was about as near the real esteem. Third, steady characteristic has changed of the range a degree however sudden trait has changed of the zone an unexpected. Fourth, we utilized focuses and region. All procedures and strategies are utilizing distinctive rule insights for gauge information. The outcomes include for nature of the estimation of models [3,4].

Ground Level Ozone

Urban areas tend to have high levels of ground level ozone. But even rural areas are subject to increased ozone levels because winds can carry ozone, and the pollutants that form it, hundreds of miles away from the original sources[5]. Ground level ozone is a common and widespread air pollutant that causes injury to the environment and human health. Exposure to ground level ozone can:

- irritate your respiratory system
- reduce lung function
- aggravate asthma
- inflame and damage cells that line your lungs
- aggravate chronic lung diseases
- cause permanent lung damage[6]

The study area

Baghdad city is located in central of Iraq, within the sector of flat sedimentary plains. The border of the municipality of Baghdad encompasses fourteen administrative units. It lies on latitude 43 east and longitude 34 north .Baghdad is suited in a plain area of elevation between 31-39 m above sea level. The climate of Baghdad region is define a semi-arid subtropical and continental, dry, hot, long summer, cool winter and short spring and autumn.

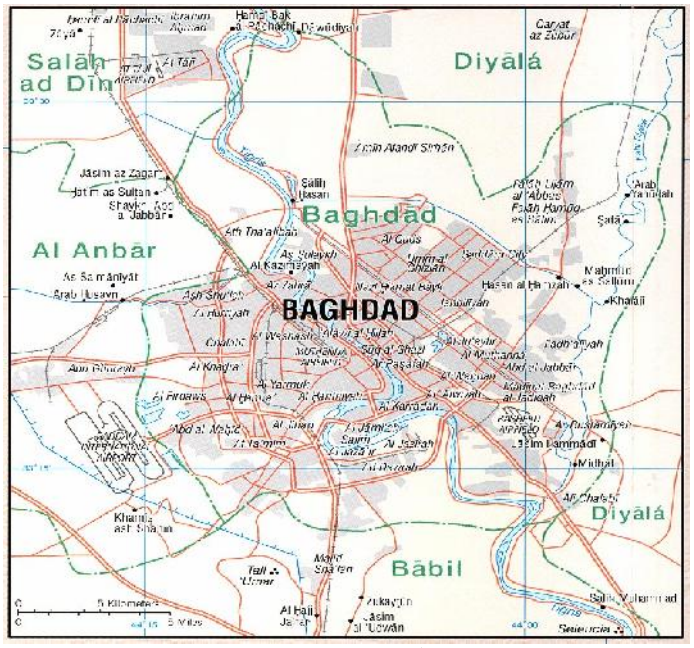


FIGURE 1: show the map of Baghdad city

METHODOLOGY

Kriging

In the event that you have a solid foundation in science, you may savor the discourse of kriging, else you will no doubt be considering, "Huh?!" If that is the situation, don't freeze! It is conceivable to do kriging without completely understanding the numerical subtle elements, as we will find in the current week's venture. On the off chance that you are probably going to utilize kriging a considerable measure in your work, I would suggest discovering more from one of the references in the (Isaaks and Srivastava's book is especially great, and incredibly decipherable given the complexities included).

Genral kriging

We consider the following model:

$$Z(s) = \sum_{j=0}^{m} \beta j X j(s) + \varepsilon(s) \qquad (1)$$

where Z(s) is the objective natural variable, s=(s1 s2)V is a two-dimensional spatial arrange, where the xj(s) are covariates (take note of that x0(s)≡1 for all s), where the βj are relapse coefficients, and where ε(s) is a regularly appropriated lingering with zero-mean and consistent change c(0). The leftover ε is conceivably spatially autocorrelated, as evaluated through an autocovariance capacity or variogram.In what tails it will be advantageous to utilize grid documentation, so that

Eq. (1) might be revamped as $Z(s) = X(s)\beta + \varepsilon(s)$…...(2) where x and β are column vectors of the m+1 covariates and m+1 regression coefficients, respectively. The universal kriging prediction at an unobserved location s0 from n observations z(si) is given by:

$$Z'(s_0) = (c_0 + X (X C^{-1} X)^{-1} (x_0 - X' C^{-1} c_0) C^{-1} z \qquad ....(3)$$

where X is the n×(m+1) grid of covariates at the perception areas, x0 is the vector of covariates at the forecast area, C is the n×n variance–covariance network of the n residuals, c0 is the vector of covariances between the residuals at the perception and expectation areas, and where z is the vector of perceptions z(si). C and c0 are gotten from the variogram of ε.The all inclusive expectation mistake change (widespread kriging difference) at s0 is given by:

$$\sigma^2 (s_0) = c(0) - c'_0 C^{-1} c_0 + (x_0 - X' C^{-1} c_0)' (X' C^{-1} X)^{-1} (x_0 - X' C^{-1} c_0) \qquad ------------(4)$$

The all inclusive kriging difference consolidates both the expectation mistake change of the lingering (initial two terms on the right-hand side of Eq. (4), and the estimation blunder fluctuation of the pattern (third term on the right-hand side of Eq. (4). By minimizing the spatial normal (or total) of the widespread kriging difference at focuses, one naturally gets the correct harmony between advancement of the example design in geographic and highlight space (5).

A disjunctive kriging approach

Each quintile of the histogram is coded by an indicator. Let us cal1 Z(x) the fish density at point x. The codification is:

$I_{z(x)>=z} = 1$ if $z(x) >= z$

$I_{z(x)>=0\ \text{otherwise}}$

for any cut-off z. The cut-off z defines in space geometrical sets referred to as A,: inside them Z(x) has values greater than $z(I_{Z(X)>=Z} =1)$; outside them Z (x) has values lower than $Z(I_{Z(X)=Z}=0)$. We study the spatial setting of the sets defined by two different cut-offs, for al1 couples of cut-offs (z, z'). The spatial setting of the sets defined by two cut-offs (z< z') can be described by a conditional probability. For instance, p (z+h)>= z' /z(x)<z, Z(x+h)>=z) is the probability that when entering in the domain of the values greater than z, a value greater than zr is encountered. Rivoirard (1993) defined also another probability for a descending order of the cut-offs, but we shall only be concerned here with characterizing the spatial setting of the quantiles for cut-offs in an ascending order.

Assuming that the bivariate distribution (Z (x), Z (x+ h) is symmetrical, the conditional rob ability can be expressed in terms of indicator variograms. Let us denote y, ***(h)*** the variogram of the indicator for the cutoff z. y,(h) quantifies the probability for a vector of length h to have one extremity inside the set A, and the other one outside it:

$$Y_z(h)=P(Z(x)>z,Z(x+h)<z)=Y_z(-h)=P(Z(x)<z ,Z(x+h)>=z)$$

Let us denote y, (h) the cross variogram between the two indicators for the cut-offs z and z'(z<zf). y, (h) quantifies the probability for a vector of length h to have one extremity inside one of the sets and the other extremity outside the other set:

$$Y_{Z\ z'}(h) = P(Z (x)>= z' , Z(x+h) < Z) =Y_Z z' (-h) = P(z(x) < z ,Z(x+h)>= z')$$

So we have:

$$P (Z(x+\_h)>= z' / Z(x)< Z, Z(x+h) >=Z)=Y_{z\ z'} (h) / Y_z(h)$$

Rivoirard (1990, 1993) has characterized different types of model by the behavior of the ratio yzL.(h)/yZ(h)I.f it is constant with h, then the sets for the higher cut-off A, are fitted inside the sets for the lower cut-off A, but there is no border effect. The sets for the hinher cut-off are not nccessarilv in the middle of the sets for the lower cut-off. We are in a model showing no spatial transition. If the ratio increases with h, there is a border effect and we are in a diffusive model. So the computation of the indicator variograms and cross variograms serves as a test to characterize the spatial scatting of the histogram quartiles. Such a test was used on the herring data (6).

RESULTS

General Kriging Interpolation method

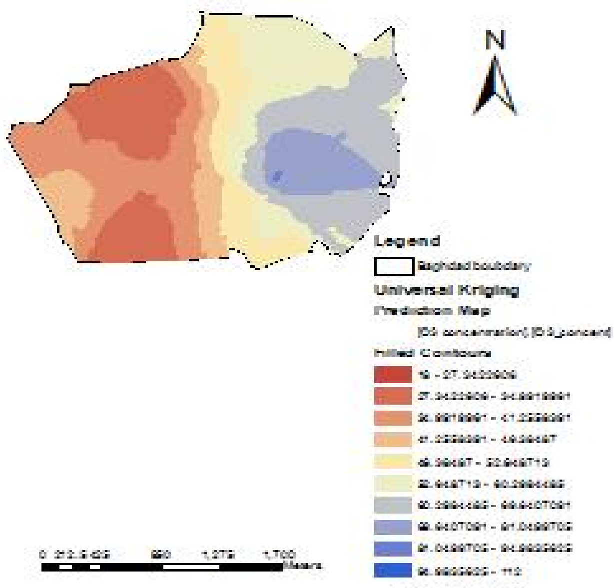
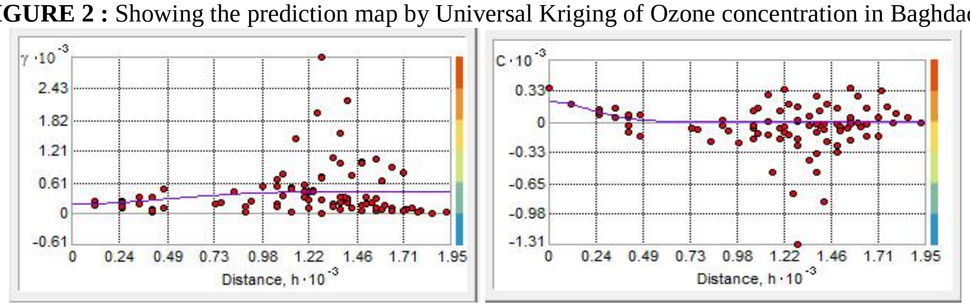


FIGURE 2 : Showing the prediction map by Universal Kriging of Ozone concentration in Baghdad.



(a) **(b)**

FIGURE 3: Illustrated the autocoralation between points, (a)for semivariogram and (b) for covariance of Ozone concentrarion in Baghdad.

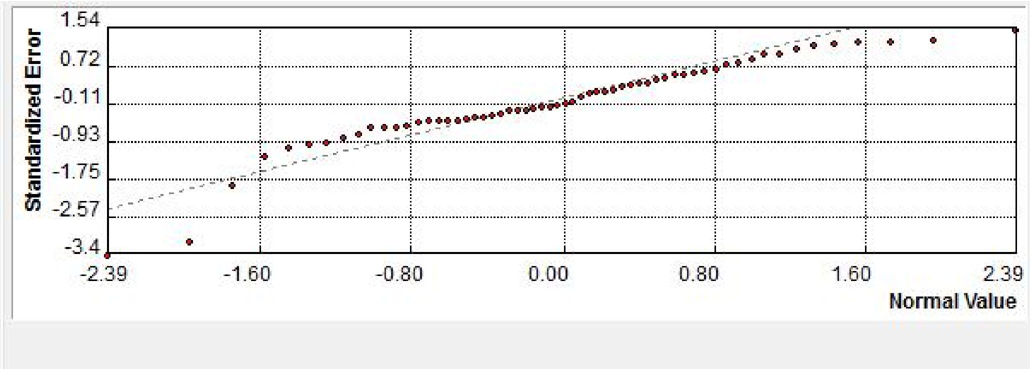


FIGURE 4: Showing the QQ Plot for error prediction

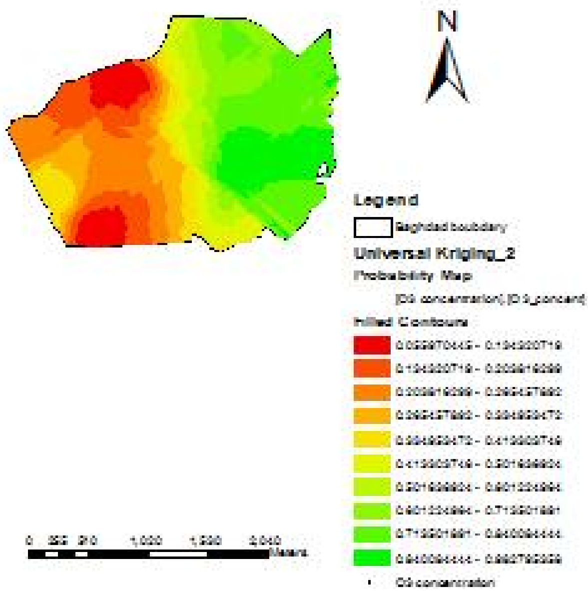


FIGURE 5: Illustrating the Probability prediction map of Ozone concentration

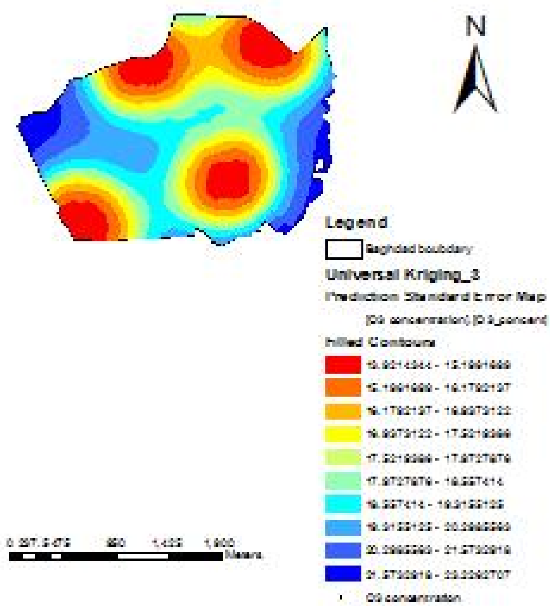


FIGURE 6 : Producing the Standard error map of Ozone concentration

Using Disjuctive Kriging

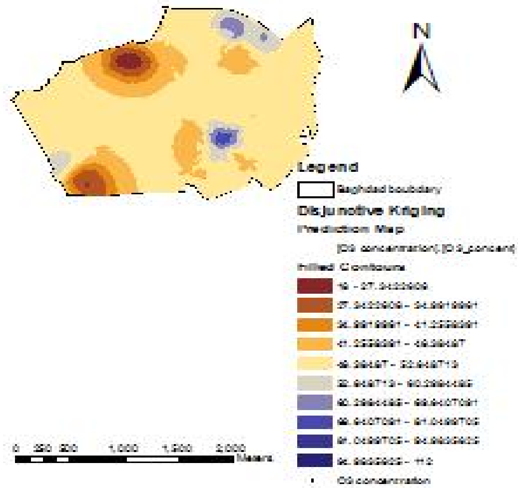
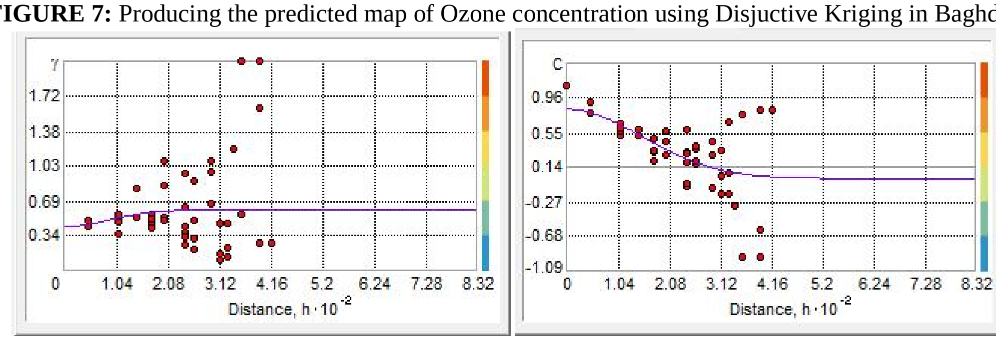


FIGURE 7: Producing the predicted map of Ozone concentration using Disjuctive Kriging in Baghdad



(a) **(b)**

FIGURE 8: Showing the autocorrelation beyween points, (a) the semivariogram and (b) the covariance

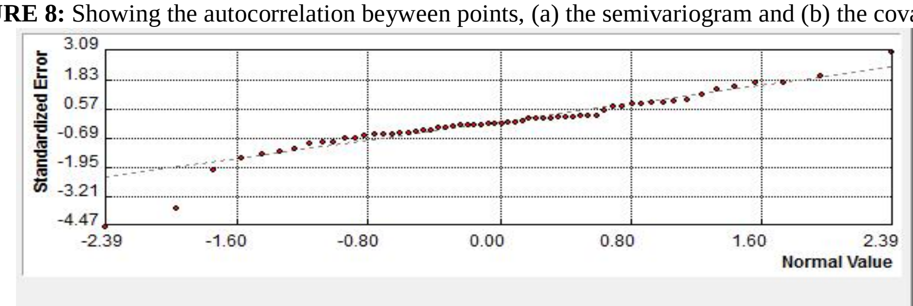


FIGURE 9: Producing the QQPlot

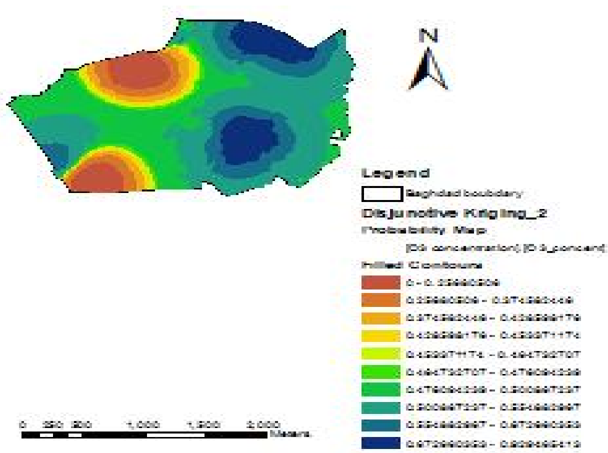


FIGURE 10 : Producing the probability map of Ozone concentration in Baghdad

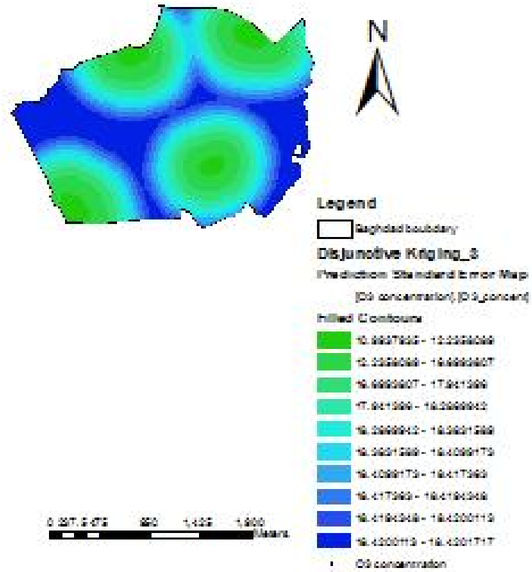


FIGURE 11 : Illustrated the Standard Error map of Ozone concentrated in Baghdad

DISCUSSION

Baghdad air pollution by ozone concentration can be directly compared with spatial trends analyzed to determine the sources of air pollution at this area. In this work, using interpolation methods that are called universal and Disjuctive Kriging to show pollution levels in Baghdad at some locations. After that it must be determine what areas in these cities have more pollution.

Figure (1) showing Ozone levels in Baghdad .Most of the north and northwest regions are qualified as having good air with respect to Ozone concentration, the scale of the predicted values at these locations about 18-52 which classified the percentage is considered good, While in the south-east the ratio of up to 94-112 While in the south-east ratio of up to 94-112, that is classified as a moderate percentage according to international standards, but they are unhealthy for sensitive groups.

These figures (3) are obtained from semivariogram, covariance modeling respectively; it can be showed the difference squared of the values between each pair of points at different distances, that determining the best fit for a model that will pass through the points in the semivariogram. The fitted model to describe the spatial autocorrelation, which illustrated the information along with the measurements of locations around the prediction location, is used to make a prediction. Figure (4), showing the QQ plot that is the measure of normality of data. The closer the points are to creating a straight line, the closer the distribution is to being normally distributed.

Figure (5) producing the probability map, because the predictions are not true values, the uncertainty associated with predictions should be provided. While the probability maps show the degree the interpolated values (values of probability located between 0.05 – 0.9).

Most areas of Baghdad having a uniform standard error, the standard error values obtained lies between 13-23, while predicting the ozone concentration values fall between 18-112 this lead to have the magnitude of Ozone standard error much lower than compared to actual concentrations (The height ozone concentration is 23 ppb, while the heist prediction value is 112 ppb. The prediction values for ozone are about four time's greatest standard error. These standard errors are fairly good). The second method of Kriging interpolation has given very close results to the first method, see figures (7, 8, 9, 10,11).At the end, to determine the good locations that hve lower air pollution by ozone concentration. The regions that have values above the EPA standard are called area with clean air.

CONCLUSION

In the current research, different geostatistical approaches are classified into deterministic, univarsial kriging, and dujustive kriging categories. Then each method is compared within each family. The primary goal of this analysis is to determine which interpolation methodology resulted in the least prediction error for the most sites in Baghdad .It can be possible to arrive at a prediction map with all error values lower than the default setting (as illustrated in figures above). The combination of prediction and prediction standard error maps (The prediction values for ozone are about four times greatest standard error. These standard errors are fairly good), two possibilities to represent this information are provided by geostatistical analysts, namely probability map shows the degree the interpolated values exceed a specified variable threshold. In general, Ozone concentration not reach potential harmful levels in Baghdad. Mapping of air pollutants allows us to see a spatial trend in Ozone concentration and interpolation are nor very useful for air pollution in Baghdad because there are too few monitoring points, but this method allows for better visualization of Ozone spatial distributions in Baghdad.

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