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Fluctuating rainfall as one of the important cause for desertification in Iraq

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Abstract

Desertification is regarded as one of the most problems over the entire world. There are many reasons lead to this problem. Climatic factors such (rainfall, temperature and evaporation) are some of them. Annual rainfall amount is one of the most important parameters that lead to desertification for this reason it chosen to achieve this research. In this paper rainfall data with the help of Geographic Information System (GIS) to produce maps of Iraqi surface climate. In order to achieve this goal, the available data from a number of climate monitoring stations located on the surface of the country has been were adopted. The annual mean of rainfall for the period from 1990 to 2010 has been used. The Iraqi shape file map was used to overlay the results. The output of the research are presented in GIS maps that demonstrating the variation of rainfall over the study period for the monitoring climate stations.

1-Introduction

Desertification is the degradation of land that could be used for agriculture or habitats and is one of the most important environmental problems that are facing today. Peoples are directly affected by desertification; about one billion people in over 100 countries are at risk. Fighting desertification is essential to ensuring the long-term productivity of inhabited dry lands [1]. There are many different causes lead to desertification and it can be classified into two types (human and climatic) factors. In this research we shall study the rainfall effect because it is one of the important reasons that lead to drought and desertification [2].

The following steps summarize the procedures implemented to accomplish this research:-

- Estimating the missing data of some months for some stations, by implementing the Statistical Product and Service Solutions (SPSS) program.
- Computing the monthly and annually mean values of rainfall for the adopted monitoring stations, by using the excel program.

- Producing annual rainfall distribution maps, using the ArcMap of ArcGIS package.

2-Study area

Iraq country lies between latitudes 29° and 38° N, and longitudes 39° and 49° E. According to FAO (1984) [3], Iraq with a total area of 438 320 km² including 924 km² of inland waters. It is surrounded by Iran to the East, Turkey to the North, Syria and Jordan to the West, Saudi Arabia and Kuwait to the South, and the Arabic Gulf to the Southeast, as shown in fig.(1).

Fig. (1): Shows the study area (Iraq and its international boundary).

Iraq country mainly consists of desert, and two major rivers (i.e. Euphrates and Tigris) surrounded by fertile alluvial plains. These plains are surrounded by mountains in the north and the east, and by desert areas in the south and west (which account for over 40% of the land area). For administrative purposes, the country is divided into 18 governorates, of which three are gathered in an autonomous region [3].

The average temperatures in Iraq range from higher than $48C^0$ in July and August to below freezing in January. A majority of the rainfall occurs from December through April and is more abundant in the mountainous region.

3-Methods

First the data rearranged and the missing values estimated by using SPSS program. As a general rule, SPSS procedures that perform computations handle missing data by omitting the missing values [4]. Second statistical study was done to calculate the mean (Y^-) which is obtained by dividing the sum of observed values by the number of observations (N). Although data points fall above, below or on the mean it can be considered a good estimate for predicting subsequent data points. The formula for the mean is given by following equation

$$\bar{Y} = \frac{1}{N}\sum_{i=1}^{N} y_i \quad \text{---------- (1)}$$

Third GIS is the tool that provides to issuance the output of this research. The ArcGIS spatial analyst extension provides tools for spatial data analysis that apply statistical theory and techniques for the modeling of spatially referenced data. Rainfall is a type of data that can be represented by surfaces. Each raster cell represents a measurement such as a cell's relationship to a fixed point or specific concentration on level. Because obtaining values for each cell in a raster is typically not practical, sample points are used to derive the intervening values using the interpolation tools in ArcGIS spatial analyst. The output of this study is shown by using kriging. It is a powerful statistical interpolation method used for diverse applications; kriging assumes that the distance or direction between sample points reflects a spatial correlation that can be used to explain variation in the surface. Simple kriging interpolation which is used in this study assume the model [5],

$$\mathbf{Z(s) = \mu + \varepsilon(s)} \text{ ---------- (2)}$$

Where μ is a known constant. In the cases of using the same data used for Ordinary Kriging and Universal Kriging concepts, the observed data is given by the solid circles.

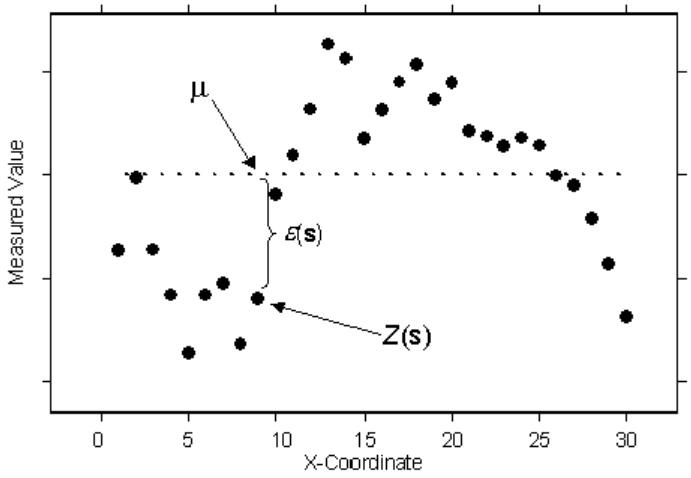

Figure (2):- Simple Kriging

The known constant—solid line—is μ as shown in fig. (2)... The difference between that model and the observations, called residuals, can be taken and use Simple Kriging on the residuals, assuming the trend in the residuals is known to be zero.

Simple Kriging can use either semivariograms or covariance's (which are the mathematical forms which use to express autocorrelation), use transformations, and allow for measurement error [5].

4-Results, discussions and conclusions

The summary of yearly precipitation data of each station is calculated from long period of recorded data, from twenty years data period at nine of the major Iraqi stations as shown in table (1). From this data, we can see that there is a variation in the rainfall amount which leads to desertification problem. Six GIS maps for annual rainfall were drawn as shown in the following figures (3-8).

Table (1):- The position of the stations used.

Station Name	Longitude	Latitude
Mosul	45.43	34.30
Kirkuk	44.40	35.47
Ramadi	43.15	36.32
Khanaqin	43.27	33.40
Baghdad	44.23	33.23
Kerbala	44.02	32.62
Najaf	44.32	31.98
Nasrya	46.23	31.08
Basra	47.78	30.57

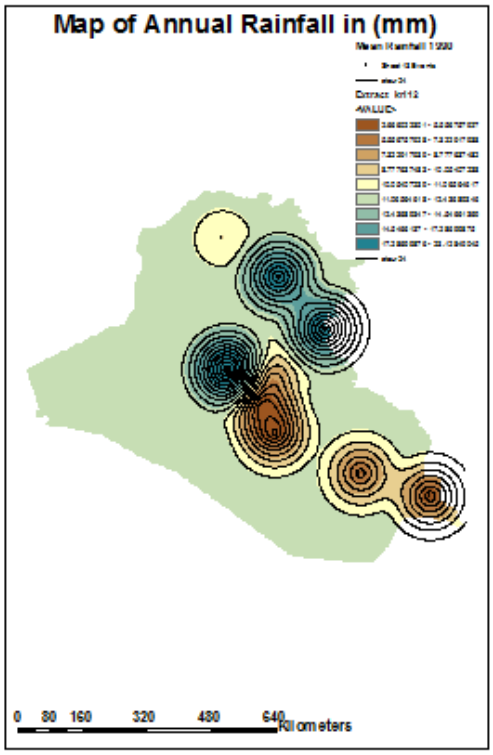

Figure (3):- Shows the annual rainfall in 1990

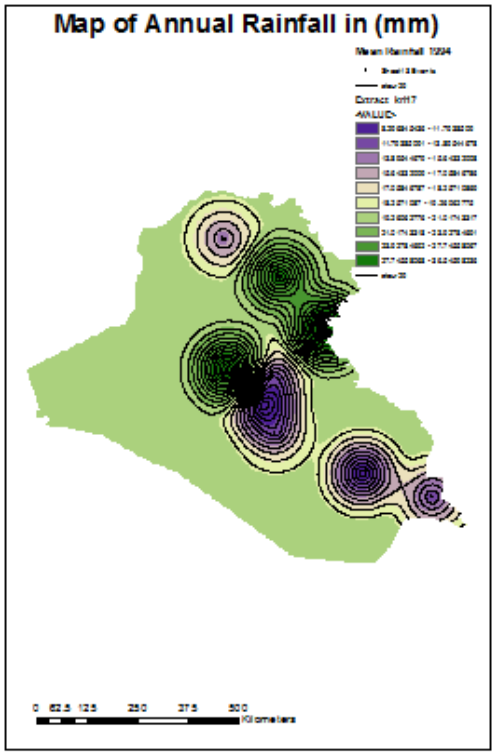

Figure (4):- Shows the annual rainfall in 1994

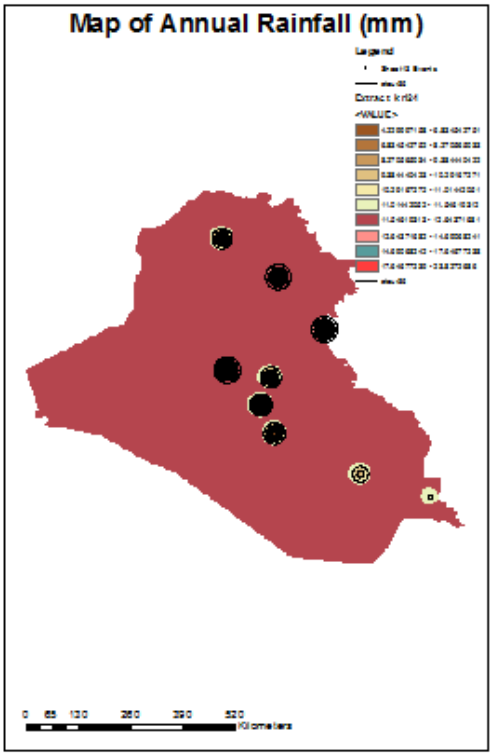

Figure (5):- Shows the annual rainfall in 1998

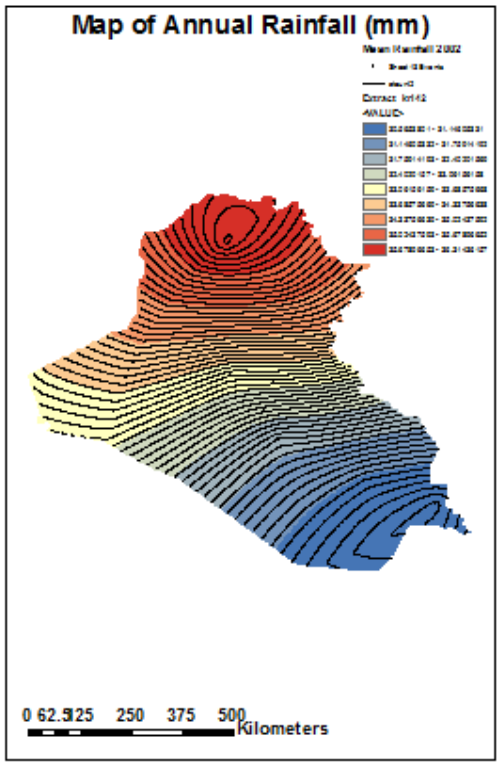

Figure (6):- Shows the annual rainfall in 2002

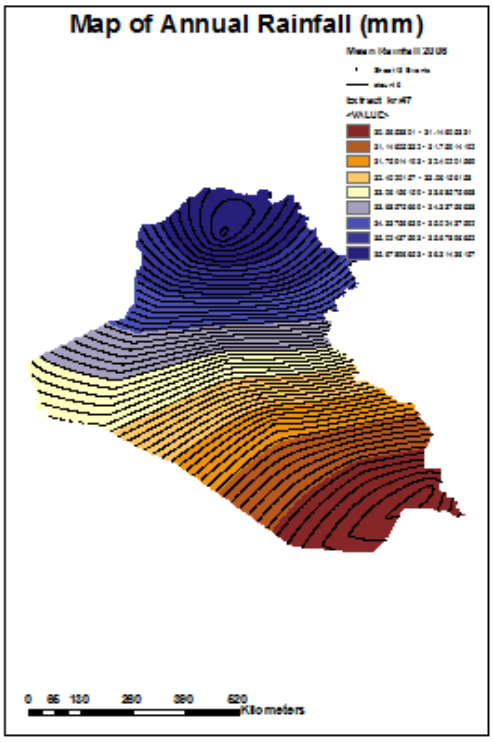

Figure (7):- Shows the annual rainfall in 2006

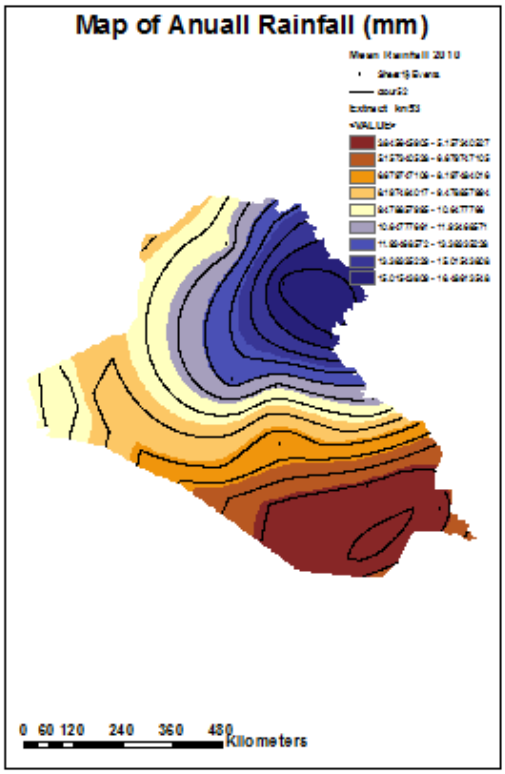

Figure (8):- Shows the annual rainfall in 2010

From the mean calculations of the rainfall, we can conclude that there is a variation in rainfall amount in the months in each year for the period of study (1990 – 2011). This variation leads to variation in the climatic and to the desertification. Rainfall range from an average January maximum mean (58.69) mm to an average August minimum mean (0.004) mm in the same year. In the period of study there is also a variation in rainfall, the maximum mean value at 2011 (29.12) mm to the minimum at 2008 and 2009 (9.06) mm. There is a variation in rainfall with the stations used in this study from the maximum mean value at Mousal station (27.42) mm to the minimum value at Najaf station (7.12). Temperatures warm quickly once rainfall begins to taper off and skies clear of the last storm clouds. Because of the arid atmosphere, the diurnal temperature spread between daily highs and lows spread as rainfall slows and then stops. Summer is hot and dry throughout Iraq and the desert is the hottest part of the country. Diurnal temperature spreads are the widest of the year in summer because the air is so dry it cannot retain heat after sunset.

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