Re –archiving Climate Data for Iraq Using GIS Technique

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Abstract

In this research, GIS techniques have been used to produce vector contour line layers for some archive climate elements that observed in 1953. These elements are average maximum temperature, average minimum temperature and the precipitation for 10 metrological stations within different regions in Iraq in two months (January and August).The outcome of this research is getting a set of new vector contour line layers as a result of using the two dimensional interpolation methods according to kirging method.

Keyword: Climate Information, Contour Line, Interpolation Methods, Satellite Images, Surface Temperature.

اعادة ارشفة بيانات المناخ للعراق باستخدام تقنيات انظمة المعلومات الجغرافية

نوال خلف غزال - قسم الفيزياء - كلية العلوم - جامعة بغداد.

المستخلص

في هذا البحث تم اســـتخدام تقنيات نظم المعلومات الجغرافية لغرض الحصـــول على طبقة الخطوط الكنتورية الشـــعاعية vector contour line layer، لعدد من العناصر المناخية الأرشيفية للعراق والتي تعود للعام 1953 ، العناصر المناخية هذه هي كل من معدل درجة الحرارة العظمى، معدل درجة الحرارة الصـــغرى والهطول المطري لعشـــرة محطات انوائية موزعة في مناطق العراق المختلفة خلال شهري آب وكانون الثاني، وتمخض من هذا البحث الحصول على طبقات جديدة من الخطوط الكنتورية للعناصـر المناخية أعلاه ،وتم ذلك بأجراء عملية الاسـتكمال الثنائي الأبعاد Two dimensional interpolation وفقا لطريقة kriging .

Keyword:المعلومات المناخية، الخطوط الكنتورية،طبق الاستيفاء،الصور الفضائية،درجة الحرارة السطحية

1- Introduction

From 1923 onward a number of meteorological observations were established in Iraq by meteorological officers of the Air Ministry, London, and since 1936, when the Iraq Meteorological Service came into being, an additional number of similar observatories, following the same practice, have been set up. All Meteorological work in Iraq since 1923, apart from that at rainfall observing stations, has been based on the practice observed by the meteorological office, London, and defined in "The Meteorological Observers Handbook" published by H.M. Stationery Office, London (1,2) .

Mean daily maximum and minimum temperatures together with extreme high and low values of temperature are also given the dates of the litter being shown by the day and year relevant to each month. The mean monthly rainfall in millimeters, the maximum rainfall in 24 hours with the date or dates of its occurrence, and the mean number of days with at least (1mm) and at least (10mm), are given in tables **devoted** to rainfall. The bulk of the data is for the period starting 1935, since there are only a few records available for earlier periods. Many gaps appear in the records of the co-operative stations and many stations **ceased** operating after a few years. Daily precipitation data for the Directorate of Meteorology stations is stored at the Climatology Office at Baghdad Airport and has been copied into the files of Hydrological Survey of Iraq (3, 4).

So there became an urgent need for archiving as spatial database according to the software ArcGIS to keep pace with modern technological used for this topic.

2-1 The Data used

1- Administrative map of Iraq as paper, with scale (1: 100,000).
2- Software used such as ERDAS, and ArcGIS.

2-2 The Methodology of work

1- It has been obtained digital map for the administrative map by using scanner A_0.
2- Using the geometric correction method to the digital map by implementation the ERDAS software.
3- Input the station of locations.
4- Input the data for climate, such as maximum, minimum temperatures, and the amount of fall rain manually.
5- Implementations one of some functions, like contour line, kriking interpolation.

Obtaining archives climate data to Iraq during the fifties of the last century.

The theoretical part

3-1 Contour lines

It is well known that, the contour lines m ay be either outlined on a visible three-dimensional model of the surface, or interpolated from anticipated surface elevations, as when a computer program gears contours throughout a network of observation points of area centroids. Interpolation is a process of building new data points within the range of a discrete set of known data points. The technique of interpolation have an effect on the consistency of individual isoclines and their depiction of slope (slope or gradient of a line describes its steepness, incline, or grade), pits and peaks() .the word **isopleth** can be used for any kind of contour line. The basis of Meteorological contour lines are the information obtained from weather stations. Weather stations may precisely be placed at a contour line and in that case, it shows an accurate measurement identical to the contour value. As a substitute, lines are drawn in order to ballpark the locations of exact values, from the speckled data points on hand. **like**, an isotherm means 'heat' and is a line that joins points with similar temperature, every one of the point through

which an isotherm goes by have the same temperatures at the designated time (5,6).

3-2 Kriging Interpolation method

It is a statistical technique that posits a certain statistical model for the data, which trying to produces an estimate of the surface by a weighted average of the data, with weights declining with distance between the point at which the surface is being estimated and the locations of the data points. The exact nature of the decline is based on modeling the conversation between data at various spatial locations. Data points, and the associated surface, at nearby locations are assumed to be more similar to each other than data points at locations that are distant from each other. There are many ways to estimate the covariance structure in spatial data and to use this information to create a kriging surface (7).

All kriging estimators are but variants of the basic linear regression estimator Z (u) defined as

$$\mathbf{Z^*(u) - m(u)} = \sum_{\alpha=1}^{n(u)} \gamma\alpha \, [Z(u\alpha) - m(u\alpha)]$$

Location vectors for estimation point and one of the neighboring data points, inexed U,Uα : by α

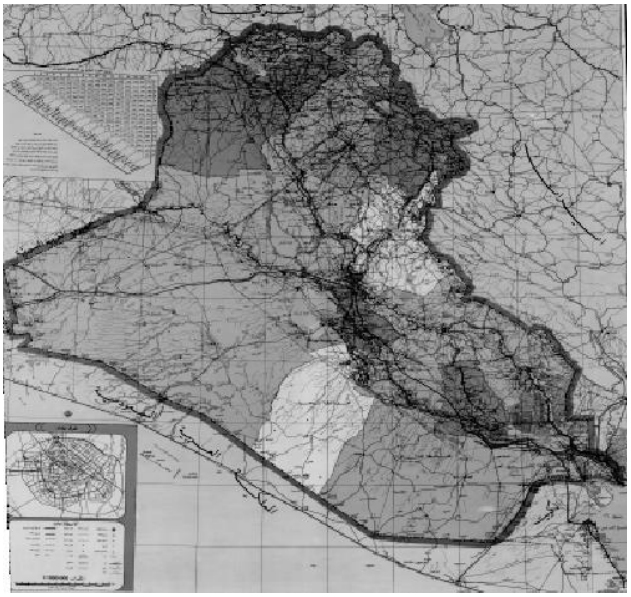
Number of data points in local neighbourhood used for estimation

Z*(u) : n(u)

$\gamma\alpha$:Kriging weight assigned to datum $Z(u\alpha)$ for estimation location u: same datum will receive different weight for different estimation location (8).

3-3 The input data

Fig (1): shows the study area (Iraq country) represented by its administrative 1:1000000 scale map, while **Table (1)**, contains some climate data (taken in January and July of 1953) for the parameters maximum temperature, minimum temperatures and the amount of rainfall.



Figure(1):The administrative map of Iraq (scale 1:100,000)

Table(1): Data for some climate parameters in some Iraqi regions

Name of provinces	January Month - 1953			July Month - 1953	
	Mean-max Temper (C)	Mean-Minim Temper (C)	Rainfall (mm)	Mean-max Temper (C)	Mean-Minim Temper (C)
MOSUL	15	9.5	11	44.2	22.2
KIRKUK	16	6.1	7	42.6	27.8
KHANAQIN	17.2	6.3	6	44.5	26.6
BAGHDAD	17.2	5.2	1	48.8	25.2
HABANIYA	17.2	5.5	1	44.1	26.9
RUTBA	14	2.7	5	89	22.2
KUT	18.7	-	5	44.1	-
DIWANIYA	17.6	5.3	4	43	25.2
NASIRIYA	18.6	7.8	4	42.6	27.1
BASRA	20.4	8.7	8	41.8	28

4 - The results of the experimental work

4-1 The results of the maximum temperature for January month in 1953

In **figure (2)** shows the Kriging method which is applied to estimate the value at a given location as a weighted sum of data values at surrounding locations and Presented the locations of stations which lying in ten provinces in Iraq.

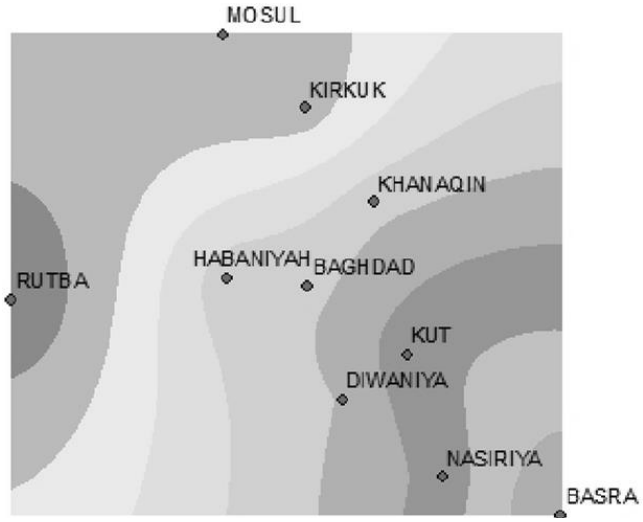


Figure (2): show locations of stations, and applied kriking method interpolation.

Figure (3) showing that all the points on a given contour line are all at the same value. If they move from one contour line to another then there is a *change* of values. The closer the lines are the 'faster' the height changes, and thus the 'steeper' the terrain. The further apart the contour lines are, the greater distance over which height changes, and so the slope is gentler. Resulting of the contour line using the result of the kriging method for maximum temperature, January, 1953.

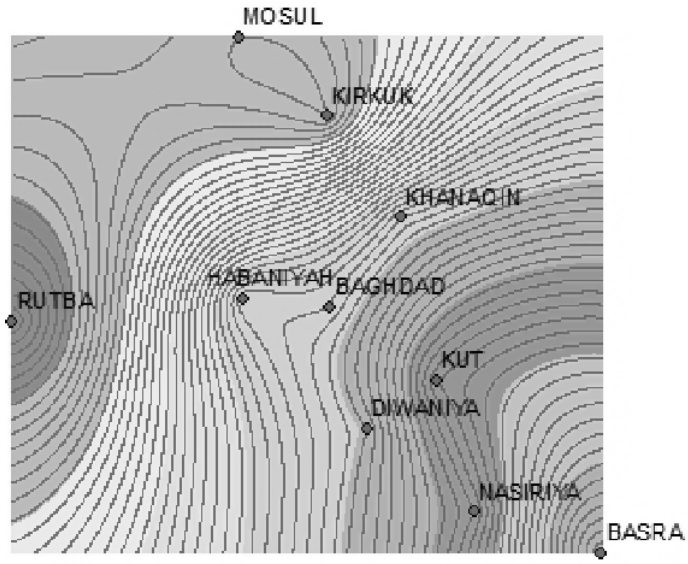


Figure (3): Show Contour line for the kriging result.

The interpolated surfaces were created by estimating the maximum temperature from ten sampled points. The created surfaces represent the max temperature of the study area.**Figure(4)** producing the distribution of the maximum temperature for the January month in1953,with the contour line(lines of constant temperature) .

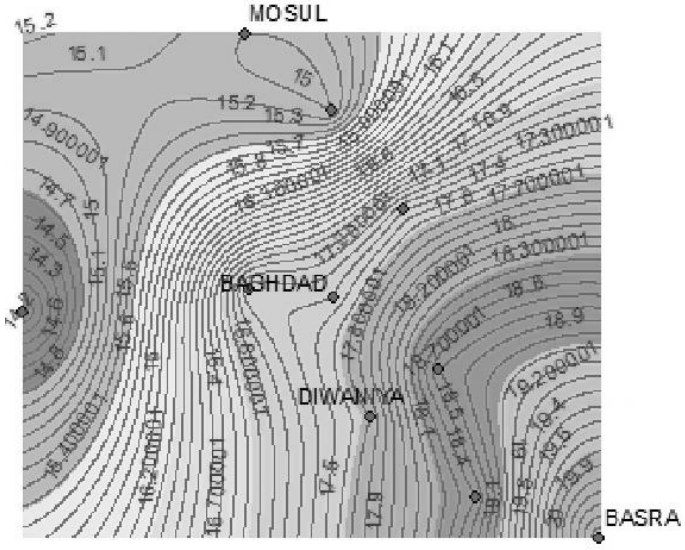


Figure (4): Show max-temperature, with contour line for kriging method, January-1953.

Figure(5) presented the contour line and the degree of the maximum temperature for the same date as above, with determine the locations of stations in different provinces in Iraq.

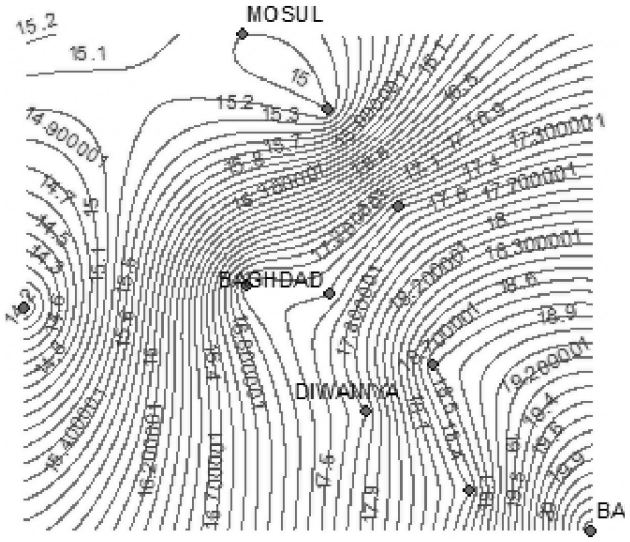


Figure (5): Show contour lines for maximum temperature-january-1953.

4-2 The results of the minimum temperature for January month in 1953

Figure(6) showing the results of kriging interpolation to estimate the value at a given location and presented the locations of stations in ten provinces in Iraq.

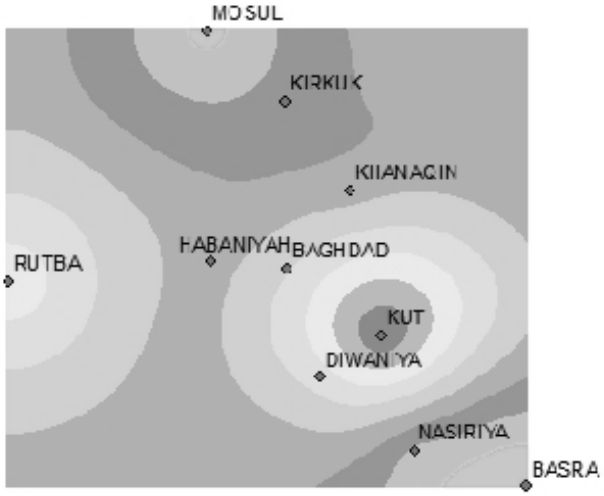


Figure (6): Show Location of stations, with kriging method.

Figure (7) showing the contour lines, each line has the same value of the minimum temperature.

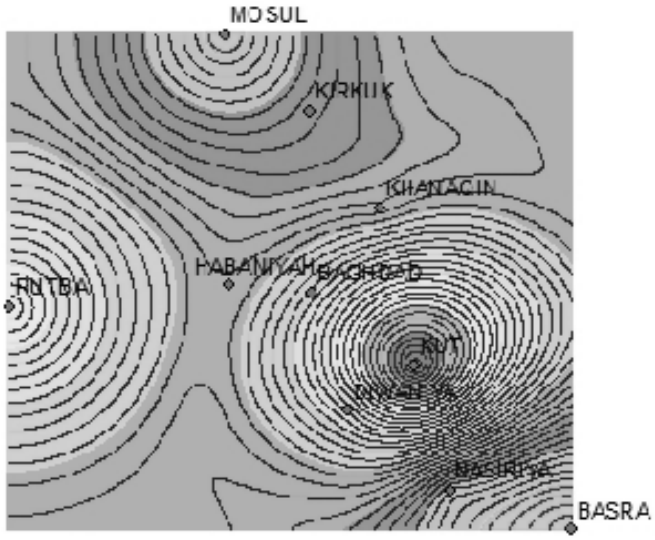


Figure (7): Show Contour line for the kriging result.

The created surfaces by kriging method represent the minimum temperature of the study area.**Figure(8)** producing the distribution of the minimum temperature for the January month in1953,with the contour line(lines of constant temperature) .

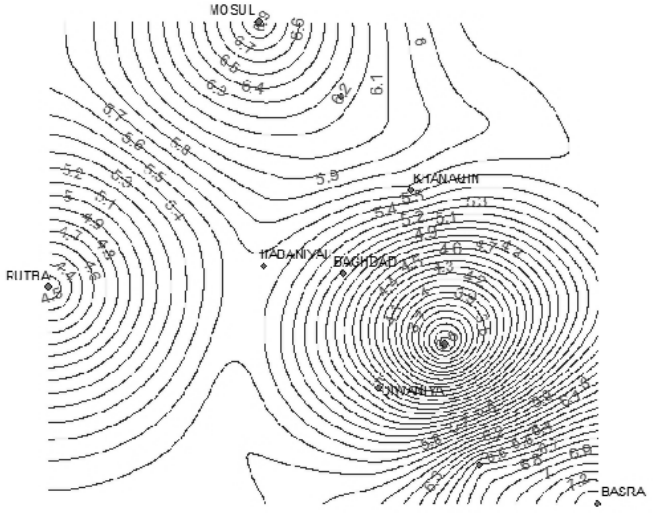


Figure (8): Show Contour lines with minimum temperature_january-1953.

4-3 The results of the rainfall l- January, 1953

Figure (9) applying kriging interpolation using the rainfall data for January month - 1953, with presentation the locations of stations.

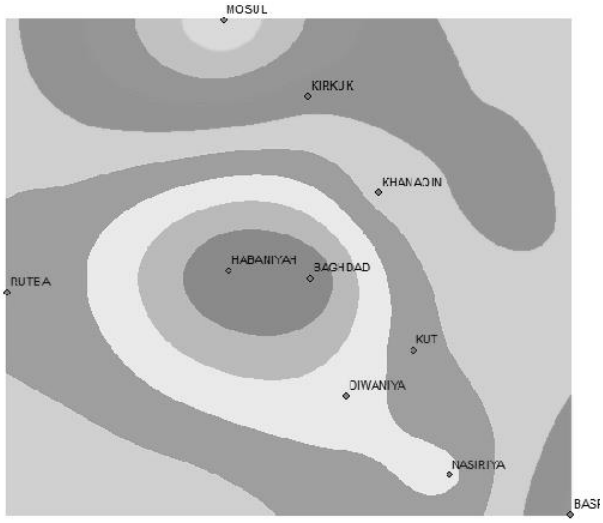


Figure (9): Location of stations, and kriging method for the data of the rainfall-january-1953.

Figure (10) determining the results obtaining from contour line. The values of these lines are changes from one contour line to another depending on the values of rain fall.

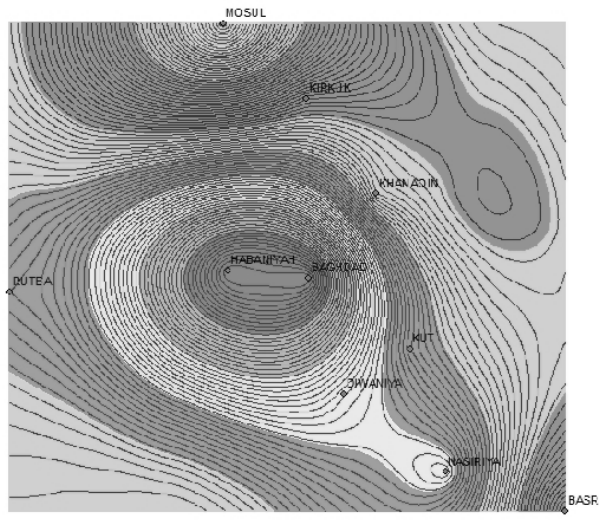


Figure (10): Contour line for the result of kriging method.

Figure (11), showing the distribution of the amount of rainfall for the January month in1953, with contour line (constant rain fall for each line).

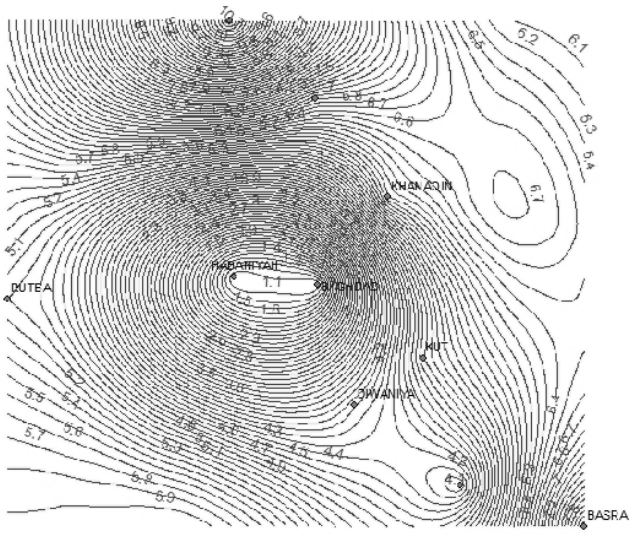


Figure (11): Contour lines with the amount of rainfall during January month-1953.

4-4 The result of maximum temperature –July-1953

Figure (12), producing kriging interpolation, contour line and locations of stations in ten provinces in Iraq.

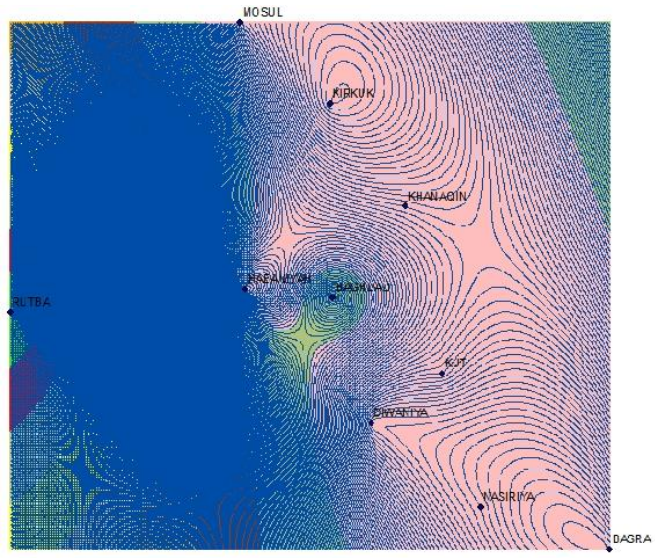
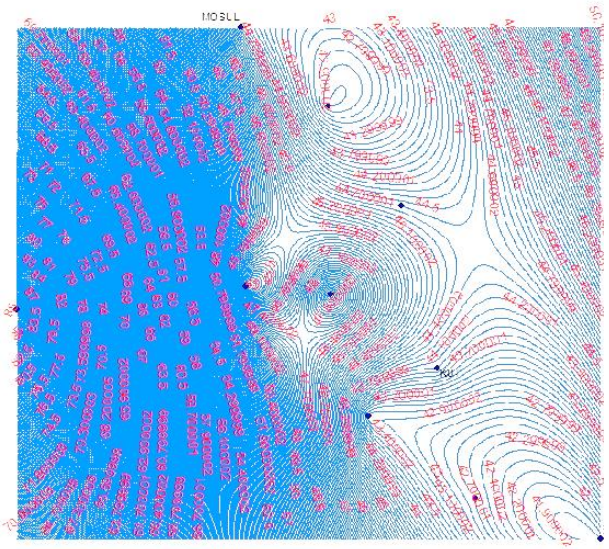


Figure (12): Location of stations, contour line, and kriging method for max-temperature-july-1953.

Figure (13), determining the distribution of maximum temperature for July month in 1953, contour line and kriking method. Absolute maximum were reached about 44.4 C.



4-5 The result of minimum temperature –July-1953

Figures(14,15)the first fig producing the locations of stations and the second fig, for the minimum temperatures shows the values of these temperatures close with each, therefore the draw producing the same color, indication that they not have a valuable different values.

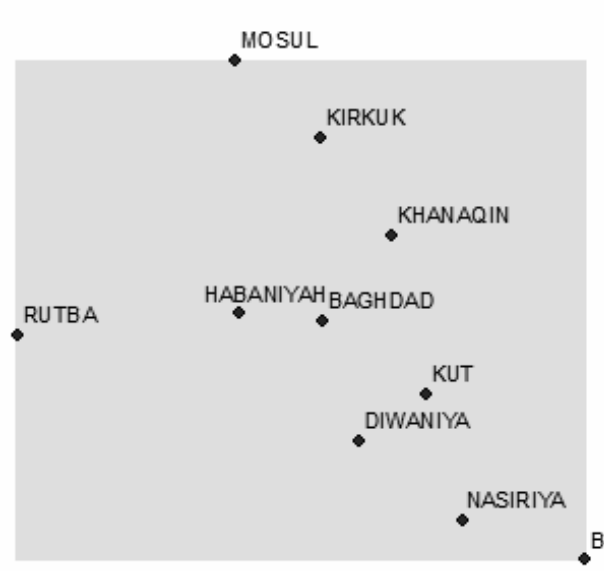


Figure (14): Location of stations and kriging method.

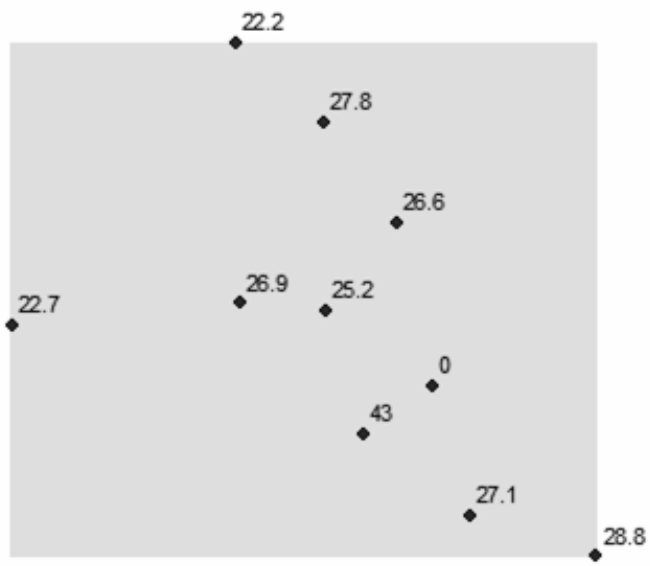


Figure (15): Contour line with minimum temperature for july-1953.

5- Conclusions

From this study it is concluded that

1- The air temperature within a specified area can be estimated in any non-measurable location.
2- The estimation process has been performed depending upon implementing kriging method. However, the results is satisfactory but the accuracy assessment of this method can not been performed without implementing other estimation (two dimensional interpolation methods that are available within ArcGIS software package) , this work is to be performed in the future.
3- The accuracy of the temperature degree depends mainly on the input 10 point data that have been taken from the climate station in the region, generally this few number of climate stations could not be enough, and it is highly recommended to increase the number of these stations.

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