Study Inverse Distance Weighting Based on Spatial Analyst

Ghusoon Idan Arb
Assist Lecturer ,Computer Engineering Dept., College of Engineering, Mustansiriyah University, Baghdad, Iraq.
Email - eng.computer38@gmail.com

Abstract: *This paper describes the digital maps that are produced from spatial analyst. Literatures suggest that there is no single preferred method of interpolation and the selection of interpolation method is usually based on the available data, desired level of accuracy, and available resources. In this paper, the Inverse Distance Weighting (IDW) method was used to estimate the spatial data distribution in Iraq. The relationship between interpolation accuracy and two critical parameters of IDW were evaluated: these were power and a radius of influence (search radius). A total of 24 stations of data between 2006 and 2016 were used in this paper. Real data, obtained from Iraqi Meteorological Organization and Seismology, are used for evaluation. The results showed that these parameters have a great effect on the produced spatial maps. The maps are produced for p is 1.5 and p is 2.0 and were having profound effect of smoothing. The results present samples of maps for months January, October, and December for the years 2004, 2012, and 2013 within the period of the data.*

Key Words: *GIS, Inverse Distance Weighted, Spatial Analyst.*

1. INTRODUCTION:

Accurate information about the climatic conditions of a region is indispensable for optimal management of agriculture, environment and related activities. Meteorological data coming from stations are the most reliable and used sources to assess the climate condition of an area [1] . IDW is an exact interpolator where the maximum and minimum values in the interpolated surface can only occur at sample points. IDW assumes that the surface is being driven by the local variation which can be captured through the neighborhood. Several methodologies exist for spatial interpolation of climate and weather parameters, among them is the inverse distance weighting [2].

2. MATERIALS:

The republic of Iraq is located in the South - West of Asia, to the North -East of the Arab homeland, bounded on the North by Turkey, on the East by Iran, on the West by Syria, Jordan and Saudi Arabia, on the South by Arab Gulf, Kuwait and Suadi Arabia. Iraq lies between latitudes 29° 5´ and 37° 22´ north and between longitudes 38° 45´ and 48° 45´ east. The area of Iraq covers 435052 Sq. Km as shown below in Figure (1),(2), Iraq is shaped like a basin, consisting of the Great Mesopotamian alluvial plain of the Tigris and the Euphrates rivers (Mesopotamia means, literally, the land between two rivers). This plain is surrounded by mountains in the north and the east, and by desert areas in the south and west, which account for over 40 percent of the land area. The Tigris and Euphrates rivers , flowing northwest to southeast before merging into the Shatt-Al-Arab and flowing into the Arabian Gulf. Other significant bodies of water nearby are the Mediterranean Sea, Black Sea, and Caspian Sea. Altitude ranges from lowest point at Arabian Gulf 0 m (mean sea level) up to highest point 3606 m. The Zagros Mountains extend up to 3000 meters in Iraq and form a natural border between the northeast region of Iraq and western Iran. The Taurus Mountains form the border between northern Iraq and southern Turkey [3].

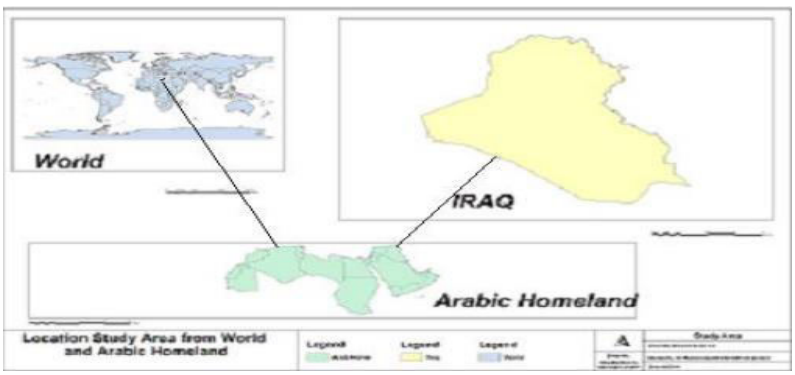

Fig.(1): Location of the study area

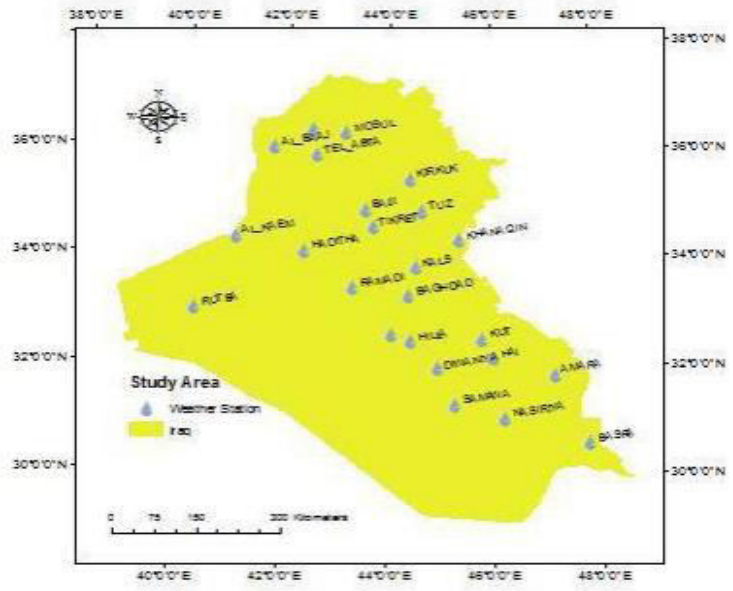

Fig.(2): Study area

3. METHOD:

IDW depends on the selection of a power parameter (P) and the neighborhood search strategy. Variable search was used, the number of points used in calculating the value of the interpolated cell is specified, which makes the radius distance vary for each interpolated cell. This depends on how far it has to search around each interpolated cell to reach the specified number of input points see Figure (3),(4).

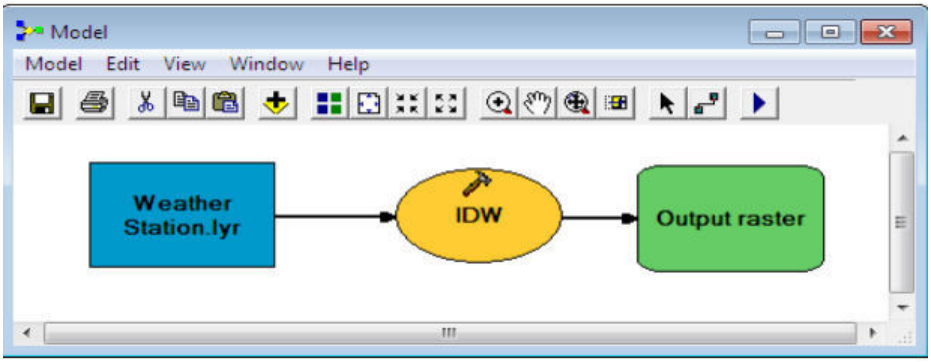

Fig.(3): IDW geoprocessing

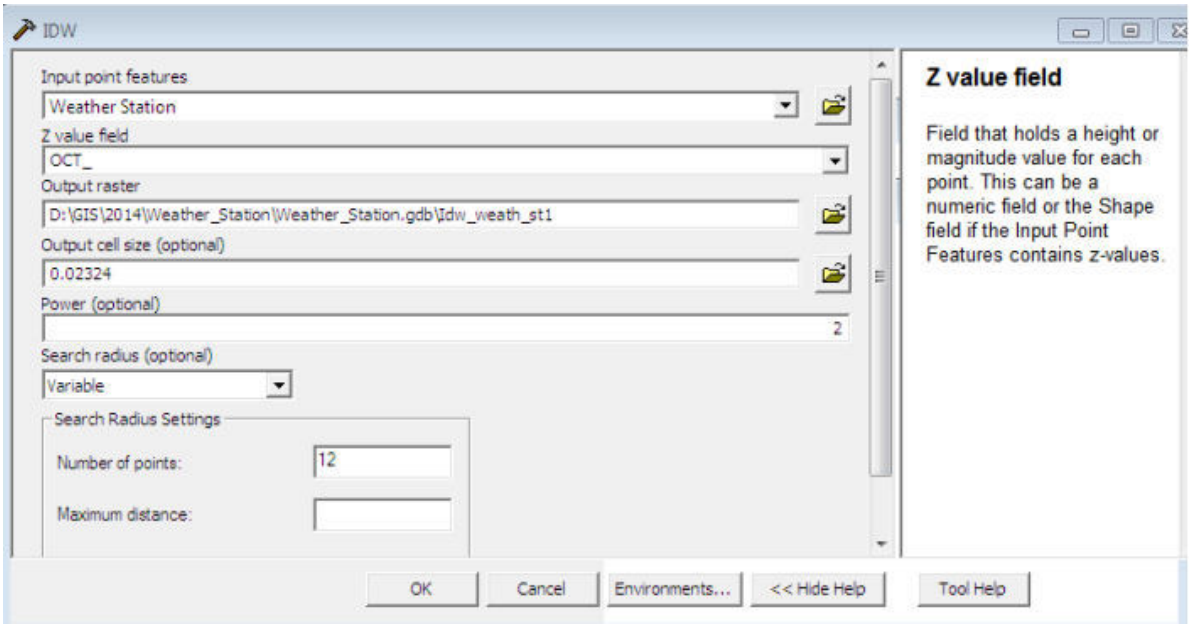

Fig.(4): IDW dialog box

4. RESULT AND DISCUSSION:

IDW is used the measured values surrounding the prediction location will have more influence on the predicted value than those farther away. Thus, IDW assumes that each measured point (weather station) has a local influence that diminishes with distance. It weights the points closer to the prediction location greater than those farther away, hence the name inverse distance weighted . The general formula is:

$$\hat{Z}(S_0) = \sum_{i=1}^{N} \lambda_i Z(S_i) \quad (1)$$

$$\lambda_i = \frac{d_{i0}^{-p}}{\sum_{i=1}^{N} d_{i0}^{-p}} \quad (2)$$

Weights are proportional to the inverse distance raised to the power p. As a result ,as the distance increases the weights decrease rapidly .How fast the weights decrease is dependent on the value for p. If p=0 there is no decrease with distance and because each weight will be the same the prediction will be the mean of all measured values. As p increases the weights for distant points decrease rapidly .If the p values is very high only the immediate few surrounding points will influence the prediction. We used value of p is equal to 2 to obtain the optimum estimation by minimizing root mean square prediction error RMSPE .The surface calculated using IDW depends on the selection of a power parameter (p) and the neighborhood search strategy. The essence of spatial interpolation is to estimate the values of unobserved points based on known sample data. Due to non-availability of abundant measurement points, reliable estimation of temperature distribution poses a great challenge. Creation of digital grid maps makes it possible to obtain climatic information at any point, whether there is a weather station or not. Multiple factors condition the difficulty of map creation, such as the location of the site samples, spatial density, spatial variability etc. The annual temperature map developed can be useful for agricultural management in the region. Reliable calculation for agricultural management and improvement of climatic models at local scales can be obtained with increased efficiency see Figure (5).

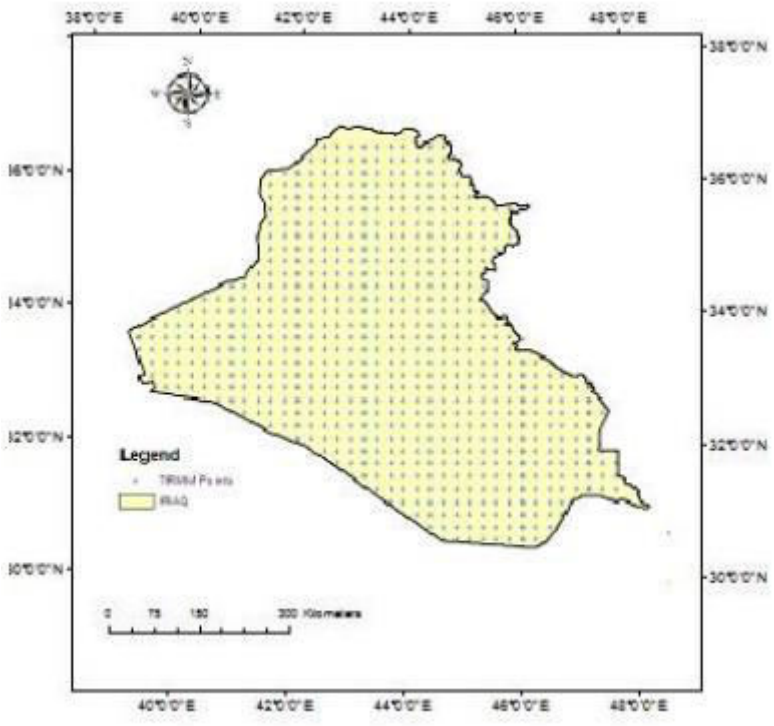

Fig.(5): Point distribution

5. CONCLUSION:

It can be concluded that IDW is a quick deterministic interpolator that is exact. There are very few decisions to make regarding model parameters. It can be a good way to take a first look at an interpolated surface. Spatial data in Iraq has been studied using IDW method in spatial analyst in GIS. Maps were produced for the last ten years because the continuous surfaces are important for agriculture , water resource management and environmental models, Inverse Distance Weighting (IDW) is a (quick) exact deterministic interpolator that requires very few decisions regarding model parameters, because it accounts for distance relationships only. This method assigns weights in an averaging function based on the inverse of the distance (raised to some power) to every data points located within a given search radius centered on the point of estimate.

REFERENCES:

1. ESRI, 2001, "ArcGIS Spatial Analyst: Advances GIS Spatial Analysis using Raster and Vector data", White Paper, ESRI, USA.
2. ArcGIS Spatial Analyst helps documentation, 2008.
3. AL-Timimi Y. K. and AL-Jiboori M. H., 2013, Assessment of Spatial and Temporal Drought in Iraq During the Period 1980-2010, International Journal of Energy And Environment,.291-302.