



ANALYSIS OF SOLAR RADIATION Data IN CIRCULAR MODEL BASED ON NATURAL NEIGHBOUR INVERSE DISTANCE WEIGHTED

Nasir Ahmed Al_awad¹, Ghusoon Idan Arb²

- 1) Assist Prof., Computer Engineering Department, Mustansiriyah University, Baghdad, Iraq.
- 2) Assist Lect., Computer Engineering Department, Mustansiriyah University, Baghdad, Iraq.

Abstract: The central qualities of sun powered radiation in Iraq are condensed, and the choice of those destinations with potential for advancement of sunlight based plants depends on the nearby most extreme sun oriented radiation. The mapping of worldwide sun powered radiation is critical in outlining of sun based vitality framework and sustainable power source applications, additionally the worldwide sun based radiation estimation and mapping will encourage designers and planner purposes and applications. In this paper estimated and evaluated worldwide sunlight based radiation information was utilized. The estimation of worldwide radiation information can give comes about with satisfactory precision to build up sun powered maps of month to month radiation utilizing Natural Neighbour Inverse Distance Weighted (NNIDW) Method with circular model.

Keywords: solar radiation, mapping methods, simulation, analysis

تحليل بيانات الإشعاع الشمسي في نموذج دائري على أساس المسافة العكسية الطبيعية للتجاوز

الخلاصة: يهدف البحث إلى رسم خرائط لشدة الإشعاع الشمسي في مختلف المناطق من العراق وبالاعتماد على البيانات الموجودة ومنها تم استنتاج الخرائط التي تعطي الواقع التقريبي لشدة الإشعاع ولكل شهر وللسنوات 2013-2014-2015. تم الاعتماد على طريقة أوزان معكوس المسافات الطبيعية لبناء الموديل الرياضي ومنه حساب معدل مربع الخطأ وقد اثبت النتائج ان شهر آب يعطي أفضل القراءات.

1. Introduction

Sun powered radiation is one of the vital fields of logical research in sustainable power source utilizes daily sunlight based radiation achieving earth surface is critical for different uses of sun based vitality including appraisal for warming and Electricity age, close planetary system outline, and horticulture meteorology [1].

Estimations of day by day add up to worldwide sun based radiation and of the length of brilliant daylight have been performed in Iraq by the Iraqi Meteorological Organization (IMO) for a long time. The measure of sunlight based radiation got by the earth surface changes with area due to the weakening properties of the environment and various

*Corresponding Author nasir.awad@uomustansiriyah.edu.iq

geographic attributes of that surface. Thus, itemized investigations of sunlight based radiation under nearby climatic conditions have been attempted in different areas [2]. Southern parts of the nation have a perfect climate, with the exception of amid periodic tidy tempests from the forsake; generally, this zone is thought to be among those that get the best measure of sun powered radiation in the world, studied different destinations the nation over: those in the south included Basra, Nasiriyah, Samawa, and Amara; in focal territories, they thought about Baghdad, Haditha, ArRutba, Karbala, Al-Hai, Najaf, and Al-Diwaniya; and in the north, they explored Kirkuk, Khanaqin, Sulaymaniyah, Mosul, and Zakho [3]. Net sun based radiation in Iraq is appeared in "Fig. 1", which uncovers that the watched net sunlight based radiation in southern and focal areas is higher than in the north

Estimations uncovered that normal aggregate yearly radiation at the southern destinations was 7263.97MJ/m², which is more prominent than at the northern locales (6318.83MJ/m²), ref. [4] have introduced examinations of the sun based radiation and daylight span for 1977– 2000 at three destinations: Tikrit, TuzKhormato, and Kirkuk. The most extreme estimations of radiation at these destinations happened in May, June, and July, with minima in January, February, November, and December. Monthly mean every day sun powered radiation, daylight term, greatest temperature, and relative stickiness information were acquired from the documents of the Iraqi.

Meteorological Office [5] for a long time at Baghdad, Mosul, and ArRutba, which identify with focal, northern, and western Iraq, individually. It can be seen that the most elevated radiation happens in June, July, and August and the least happens in January and December. The assessed daylight and worldwide sunlight based radiation at three locales (more than 17 years) in the north and west of the country, Haditha, Beji, and Samara [6].

Baghdad gets more than 3000 h of sunlight based brilliance a year [7,8] Hourly sun MJ/m² in January and 9686 MJ/m² in June. oriented power differs between 4836 Numerous examinations have been embraced to decide delegate conditions of the sun based force in Baghdad. Distinctive down to earth and hypothetical investigations have been started in Iraq to contemplate sunlight based controlled local water warmers and coolers [9] and to build hypothetical models for sun oriented water radiators. These examinations have shown homogeneity between the hypothetical and the pragmatic outcomes [10]. In this manner, these investigations have modified the manner by which upgrades in the effectiveness of sun powered cells for control age are accomplished [11]. Trial examinations of Trombe dividers have affirmed the capability of sunlight based vitality amid winter in Iraq [12]. Information concerning the reasonability of the sun powered radiation are significant for elucidating the financial case for sun powered vitality innovation. It is imperative to gauge this information in all territories to assess completely the potential points of interest of sunlight based vitality.

More considered shows, sun oriented vitality radiation increments from north to south and increments in summer contrasted and winter. It is seen that there is more uniform dispersion to the radiation crosswise over Iraq amid summer (June– August). Assessment of sunlight based radiation relies upon connections got from the information got from meteorological stations in urban communities and extensive towns.

These zones get less radiation than their surroundings in view of the impacts of contamination, and accordingly the genuine radiation esteems are higher than those deliberate [13].

Sunlight based radiation estimations in our nation are not effectively accessible as a result of not having the capacity to manage the cost of the estimating supplies and systems required, keeping in mind the end goal to beat this deficiency of sun oriented radiation estimations.

Numerous specialists created models to assess the estimations of sun powered radiation achieving the earth surface by utilizing diverse relations, for example, direct, multi straight, fourth request and polynomial for various area in Iraq and encompassing nation. On other hand, analysts of the neighbouring nations, for example, Turkey, Syria, Jordan, Saudi Arabia, Iran researched observational and factual models [14].

The Heliosat-2 technique is portrayed in subtle elements by numerous creators. The month to month albedo maps get from the everyday albedo esteems is figured for every pixel of Meteosat-8 pictures [15].

Geostatistics can be viewed as a gathering of numerical methods that arrangement with the portrayal of spatial characteristics. Utilizing principally arbitrary models in a way like the manner by which time arrangement examination portrays fleeting information [16]. The round capacity is a standout amongst the most much of the time utilized models in geostatistics. The circular model is great decision when the piece fluctuation is critical yet not very extensive [17]. The estimation of worldwide radiation information can give comes about with adequate precision to set up sun based maps of month to month radiation utilizing Geographic Information Systems (GIS) programming [1].

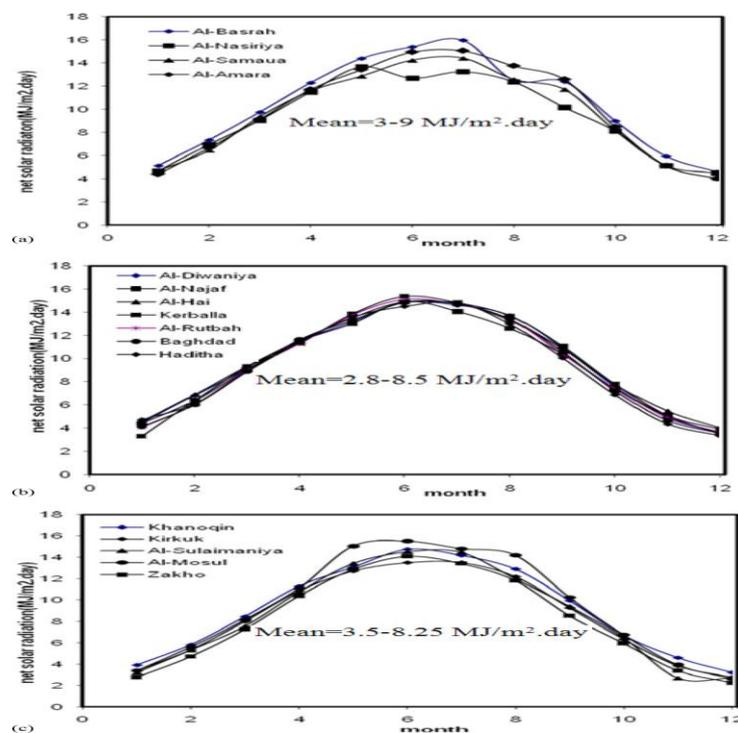


Figure 1. Net solar radiation (a) southern Iraq, (b) central and western Iraq and (c) northern Iraq.

2-Natural Neighbour Inverse Distance Weighted (NNIDW) Manner

Natural neighbor interpolation has many interested features, it may be used in interpolation and extrapolation, and usually works good with clustered scatter focal points. Also weighted- average method, the simple equation used in natural neighbor search is similar to the another one used in IDW. This method can efficiently and effectively handle massive input point datasets. When using this method the Natural Neighbor method, native coordinates assign the amount of impact any scatter focal point will have on output cells. see "Fig. 2"

The Natural Neighbor method is a geometric assessment manner that uses natural neighborhood areas created around any point in the dataset.

Same IDW, this interpolation maner is a weighted-average method. Anyway, instead of searching an interpolated points using all of the entered points according by the distance, Natural Neighbors interpolation generates a Delauney Triangulation of the input values and takes the closest points that give a convex hull concerning the interpolation node, then weights their points by proportionate region. This manner is most appropriate where simple data nodes are spread with odd density. It is well common purpose interpolation technique and has the feature that it does not have to specify variables such as radius, number of neighbor's or weight's.

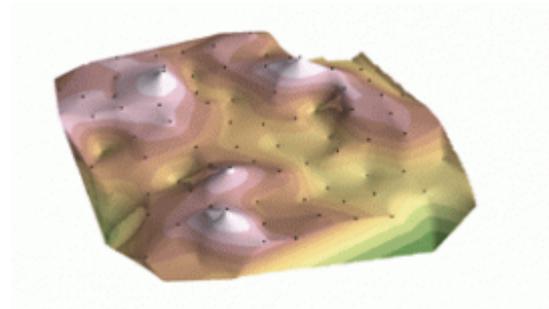


Figure 2. Natural Inverse Distance Weighted

This manner is designed to dominate local minimum and maximum account in the node file and can be set to determine overshoots of local high points and undershoots of local low points. The technique thereby allows the generation of accurate map models from datasets that are very sparsely calculated or very linear in spatial distribution. Advantage of this model it handles large numbers of sample points efficiently. See "Fig. 3" and "Fig. 4" to understand the method for analysis and producing solar radiation data map in NNIDW method with circular model.

The general equation that is used to determine the predicted point is:

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

Where X_o is the location of the estimated point, $\hat{Z}(X_o)$ is the value that are attempting to interpolate for location X_o , N is the number of known sample nodes enclosure the prediction location that will be used in the interpolation, λ_i is the weight allocated to the known points that are going to use. These weights will lower with distance. $Z(X_i)$ is the measured value at the location X_i . As the distance turn into larger, the weight is decreased by weight of p. The equation to determine the weights is

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

And

$$\sum_{i=1}^N \lambda_i = 1$$

The quantity $d_{i(o)}$ is the distance between the unknown location X_o and each of the observed locations x_i . λ_i is the weight determined to the known nodes that are going to use.

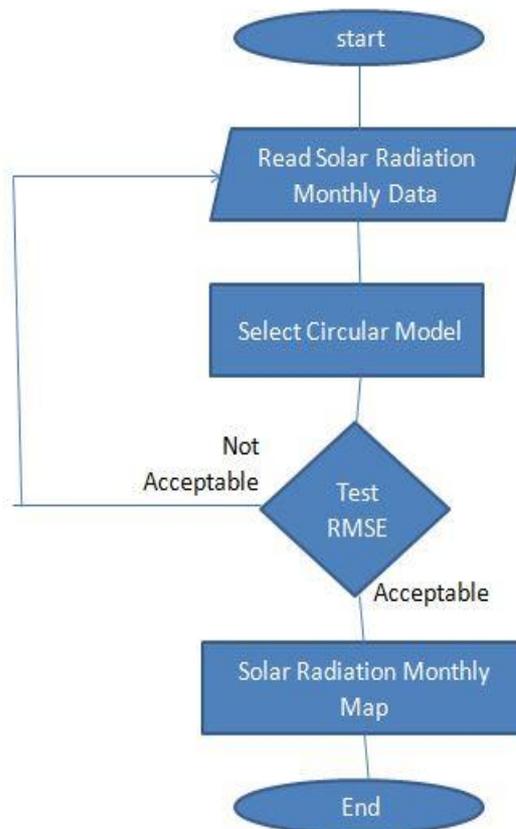


Figure 3. System Flow Chart.

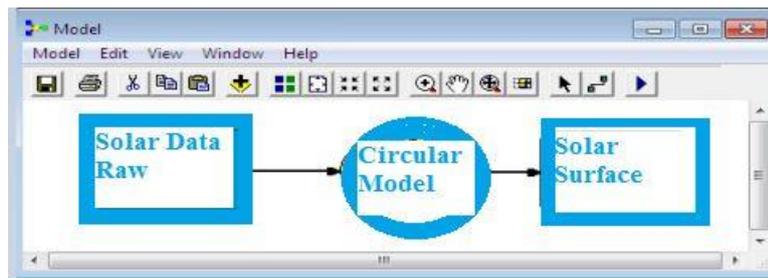


Figure 4. Geoprocessing Code.

3-Results and Discussion

In this paper weather stations radiation data were used for the years 2013 to 2015. Data have been analyzed and produced by using Excel, ArcGIS 10.1 is used for spatial interpolation and mapping activities.

Surface radiation Maps have been generated by using ArcGIS in NNIDW interpolation technique in circular model. Experimental results show that the circular model has very good level of accuracy and a predictable manner. "Fig. 5" represent sample of produced maps of solar radiation. "Table 1", shows example sets of experimental results.

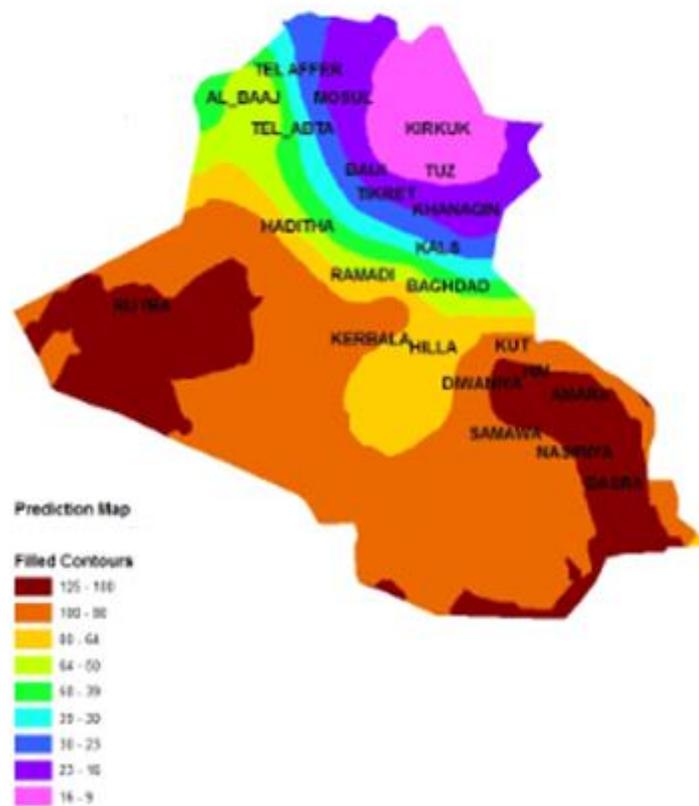


Figure 5. Experimental sample sets for August 2015.

Table 1. Example Sets of Experimental Results

Time	Model	RMSE
March/2013	Circular	0.8745
March /2014	Circular	0.9654
March /2015	Circular	0.3302
June/2013	Circular	0.8627
June /2014	Circular	1.093
June /2015	Circular	0.7629
July/2013	Circular	0.958
July/2014	Circular	1.0772
July/2015	Circular	0.9580
August/2013	Circular	0.9231
August /2014	Circular	0.9322
August /2015	Circular	0.9726

It was found that the Circular model gives best results especially in August month for three years because root mean square error nearest to one .

4-Conclusions

In conclusion, this paper has explained a suitable approach and analysis to interpolate solar data values for recent and future periods. The method NNIDW have been successfully implemented in GIS for efficient production and mapping of the spatial and temporal variation of solar data. The spatial interpolation greatly enhanced the level of detail which is useful for climate impact assessments at local area.

5-References

- 1- Hussain, Z. Ali and Ali, M. (2016). "Mapping Monthly Average Global Solar Radiation over Iraq Using GIS and Heliosat Model", International journal of Computers & Technology, Volume 15, Number 0 5.
- 2- Darwish, A.S.K. and Sayigh, A. A. M. (1988). "Wind energy potential in Iraq," journal of wind energy and ind.
- 3- Abdul-Wahid, S. N. and Hassan, A. M. (2010). "Solar energy status in Iraq: Abundant or not—Steps forward", Pure Sci. 15, 1.
- 4- Abed, F. M. and Mohammed, G. Y. (2012). " Empirical Models For The Correlation With Sunshine Duration of Metrological Data For Tikrit-TuzKhurmato and Kirkuk-IRA," Tikrit,J. Eng. Sci. 19, 1.
- 5- Al-Salihi, A. M., Kadum, M. M. and Mohammed, A. J. (2010). " Estimation of Global solar radiation on horizontal surface using routine measurement for different cities in Iraq" Asian J. Sci. Res. 3, 240.
- 6- El Bassam, N., Maegaard, P. and Schlichting, M. L. (2013). "Chapter Fourteen - Current Distributed Renewable Energy Rural and Urban Communities" in Distributed Renewable Energies for Off-Grid Communities.

- 7- Kazem, H. A. and Chaichan, M. T. (2012). "Status and future prospects of renewable energy in Iraq". Renewable Sustainable Energy. Rev.16, 6007.
- 8- Dihrab, S. S. and Sopian, K. (2010). "Electricity generation of hybrid PV/wind systems in Iraq", Renewable Energy 35, 1303.
- 9- Al-Riahi, M., Al-Hamdani, N. and Al-Saffar, H. (1992). "Some aspects of solar radiation climatology of Iraq", Renewable Energy 2, 167.
- 10- Anagreh, Y., Bataineh, A. and Al-Odat M. (2010). "Assesment of renewable energy potential, at Aqaba in Jordan", Renewable Sustainable Energy Rev.14, 13
- 11- Abass, K. and Chaichan, M. T. (2009). "Experimental study of using solar energy storage wall for heating Iraqi houses purposes", Wassit J. Sci. Med. 2, 212
- 12- Ahmed, I., Al-Hamad, N. and Ibrahim, K. (1983). "Solar radiation maps in Iraq", Sol. Energy 31, 29.
- 13- Sissakian, V. K., Ajar, D. and Zaini, M. T. (2012). "Certification influence on the drainage system, examples from the Iraq southern desert" Iraqi Bull. Geol. Min. 8, 99.
- 14- AL-Salihi, A. M., M, K. M. and Mohammed, A. J. (2010). "Estimation of Global Solar Radiation on Horizontal Surface Using Routine Meteorological Measurements for Different Cities in Iraq", Asian Journal of Scientific Research, 3, 4, 240-248, April 01.
- 15-Diabate, L., Demarcq, H., Michaud, N. and Wald, L. (1988). "Estimating Incident Solar Radiation at the Surface from Images of the Earth Transmitted by Geostationary Satellites", the Heliosat project, Int. J. Remote Sens, 5.
- 16- Deutsch, C.V. (2002). "Geostatistical Reservoir Modeling", Oxford University Press.
- 17-Webster, R. and Oliver, M. A. (1999). "Geostatistics for Environmental Scientists", Chichester: Wiley.