International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 6 Issue 4, April - 2022, Pages:34-41

GMGD: Geospatial Measuring Geographic Distributions Cellular Phone Towers

Dr.Taha Alfadul Taha Ali

Geospatial Data Science,
Associate Professor of Information Technology, Alzaiem Alazhari University
Tahapilot13@gmail.com

Abstract *- This study illustrates Measuring Geographic Distributions Cellular Phone Towers in Khartoum using Geospatial technology, the motivations depend on GeoSmart city has become one of the hot issues of Geoinformatics technology and applied in Africa& Asia country. The objectives as to identify, create, and measure Central Feature, Directional Distribution, Mean Center, Median Center and Standard Distance for Towers. There are 226 Towers in Khartoum Locality: 90 Towers (in Khartoum East), 19 Towers (in Khartoum west), 19 Towers(in Khartoum Central), 78 Towers(in Khartoum Soba), 10 Towers(in Khartoum Al-shagrah). Hug Towers impacts for our life's. in addition to measure Geographic Distributions Cellular Phone Towers in Khartoum. There are many future researches: GEMS(Global Environment Monitoring System), Geoinformatics GeoSmart City: Pollutions for Cellular Phone Towers, GEMS-Geoinformatics GeoSmart City: The Environment pollution and Electromagnetic radiation pollution, Geospatial Technology: Spatial Statistic for Measuring Geographic Distributions Cellular Phone Towers in Khartoum, GEMS-Geoinformatics GeoSmart City: Spatial Statistic for Measuring Geographic Distributions Cellular Phone Towers in Khartoum.*

Keywords-GIS**,** Remote Sensing, GEMS; Electromagnetic Environmental Pollutions; Electromagnetic radiation, electromagnetic environment; electromagnetic compatibility.

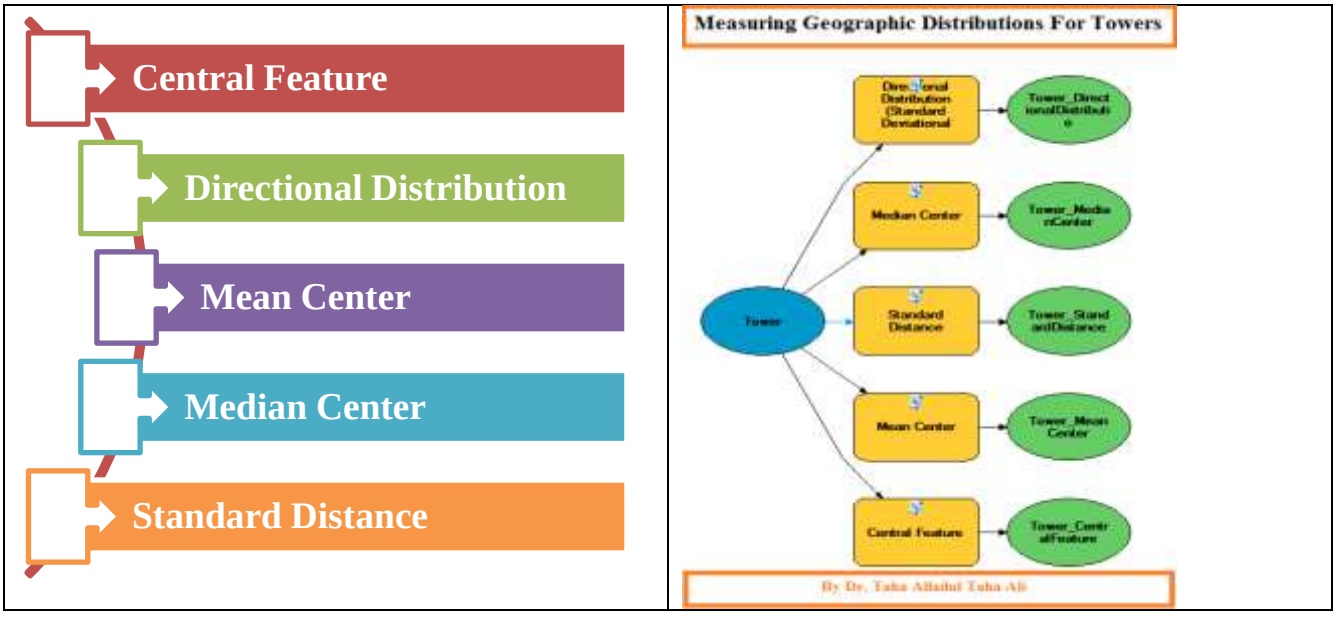
1. INTRODUCTION

Measurement of the distribution allows us to calculate the value of the distribution such as mean, direction, etc. [1].

There are many Questions: Where is the center? , what is the shape and orientation? , and How dispersed are the Towers in Khartoum? In addition to there are many Objectives: To identify, create, and measure Central Feature, Directional Distribution, Mean Center, Median Center and Standard Distance for Towers. Study on atmospheric aerosols in Khartoum [2], [3], [4], [5]. There are many research related [6], [7], [8], [9], [10] , [11], [12], [13], [14], [15] , [16], [17], [18], [19], [20] , [21],[22],[23],[24],[25],[26],[27],[28],[29],

2. METHODOLOGY

This is methodology depend on five steps: Central Feature, Directional Distribution, Mean Center, Median Center and Standard Distance.



The Standard Deviational Ellipse is given as: $$SDE_x = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{X})^2}{n}} \quad (1)$$ $$SDE_y = \sqrt{\frac{\sum_{i=1}^{n}(y_i - \bar{Y})^2}{n}}$$ where x_i and y_i are the coordinates for feature i, $\{\bar{X}, \bar{Y}\}$ represents the Mean Center for the features, and n is equal to the total number of features. The angle of rotation is calculated as: $$\tan\theta = \frac{A+B}{C} \quad (2)$$ $$A = \left(\sum_{i=1}^{n}\tilde{x}_i^2 - \sum_{i=1}^{n}\tilde{y}_i^2\right)$$ $$B = \sqrt{\left(\sum_{i=1}^{n}\tilde{x}_i^2 - \sum_{i=1}^{n}\tilde{y}_i^2\right)^2 + 4\left(\sum_{i=1}^{n}\tilde{x}_i\tilde{y}_i\right)^2}$$ $$C = 2\sum_{i=1}^{n}\tilde{x}_i\tilde{y}_i$$ where $\tilde{x}_i$ and $\tilde{y}_i$ are the deviations of the xy-coordinates from the Mean Center. The standard deviations for the x-axis and y-axis are: $$\sigma_x = \sqrt{2}\sqrt{\frac{\sum_{i=1}^{n}(\tilde{x}_i\cos\theta - \tilde{y}_i\sin\theta)^2}{n}} \quad (3)$$ $$\sigma_y = \sqrt{2}\sqrt{\frac{\sum_{i=1}^{n}(\tilde{x}_i\sin\theta + \tilde{y}_i\cos\theta)^2}{n}}$$	The Mean Center is given as: $$\bar{X} = \frac{\sum_{i=1}^{n}x_i}{n}, \quad \bar{Y} = \frac{\sum_{i=1}^{n}y_i}{n} \quad (1)$$ where x_i and y_i are the coordinates for feature i, and n is equal to the total number of features. The Weighted Mean Center extends to the following: $$\bar{X}_w = \frac{\sum_{i=1}^{n}w_ix_i}{\sum_{i=1}^{n}w_i}, \quad \bar{Y}_w = \frac{\sum_{i=1}^{n}w_iy_i}{\sum_{i=1}^{n}w_i} \quad (2)$$ where w_i is the weight at feature i. The tool also calculates the center for a 3rd dimension if a z attribute exists for each feature: $$\bar{Z} = \frac{\sum_{i=1}^{n}z_i}{n}, \quad \bar{Z}_w = \frac{\sum_{i=1}^{n}w_iz_i}{\sum_{i=1}^{n}w_i} \quad (3)$$
Directional Distribution (Standard Deviational Ellipse)	Mean Center

$$d_i^t = \sqrt{(X_i - X^t)^2 + (Y_i - Y^t)^2}$$	The Standard Distance is given as: $$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{X})^2}{n} + \frac{\sum_{i=1}^{n}(y_i - \bar{Y})^2}{n}} \quad (1)$$ where x_i and y_i are the coordinates for feature i, $\{\bar{X}, \bar{Y}\}$ represents the Mean Center for the features, and n is equal to the total number of features. The Weighted Standard Distance extends to the following: $$SD_w = \sqrt{\frac{\sum_{i=1}^{n}w_i(x_i - \bar{X}_w)^2}{\sum_{i=1}^{n}w_i} + \frac{\sum_{i=1}^{n}w_i(y_i - \bar{Y}_w)^2}{\sum_{i=1}^{n}w_i}} \quad (2)$$ where w_i is the weight at feature i and $\{\bar{X}_w, \bar{Y}_w\}$ represents the weighted Mean Center.
Median Center	Standard Distance

3. IMPLEMENTATION

We analysis Cellular phone towers in Khartoum city, and we design and implementation the Cellular phone towers Geodatabase. The below figure show the Cellular phone towers Map in Khartoum north administrator.

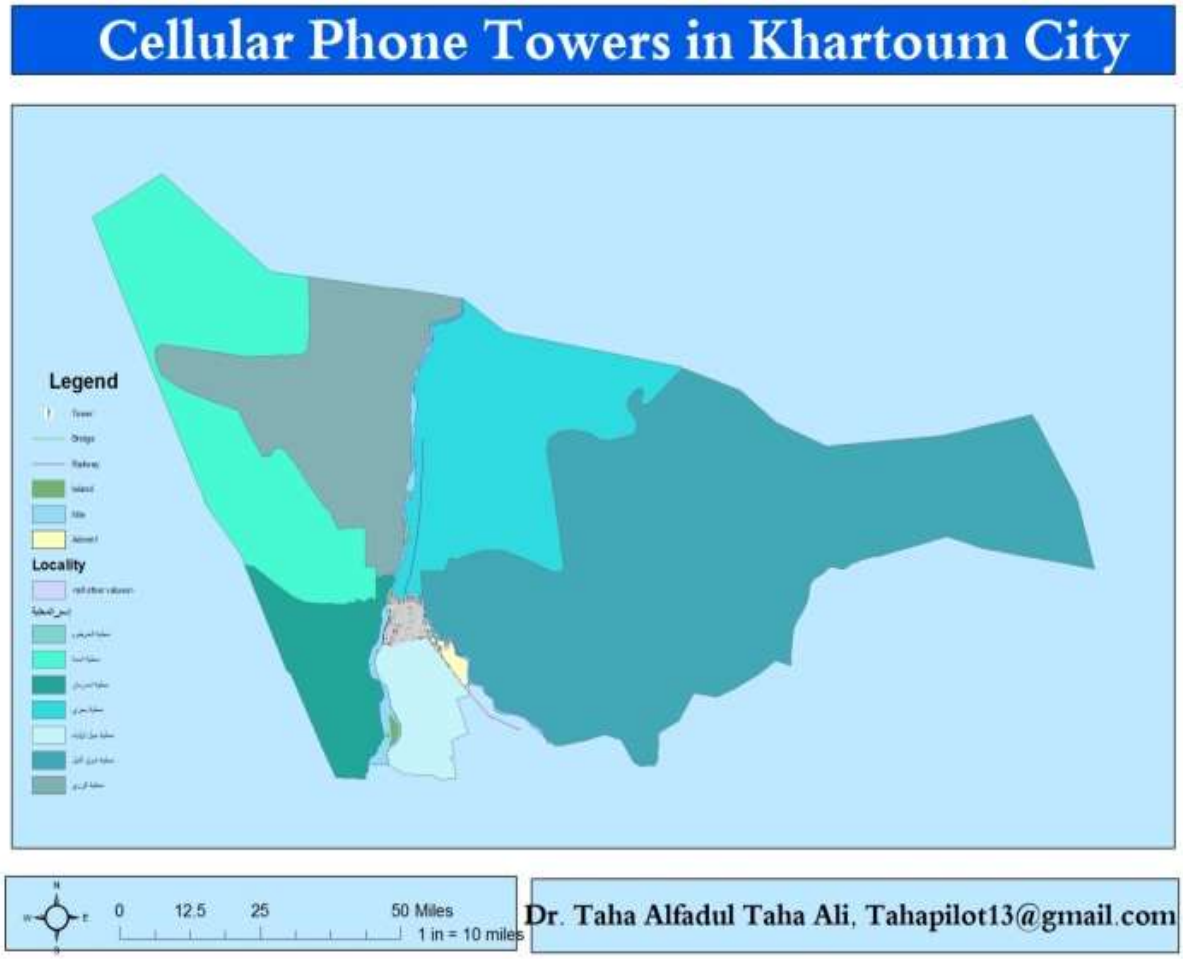
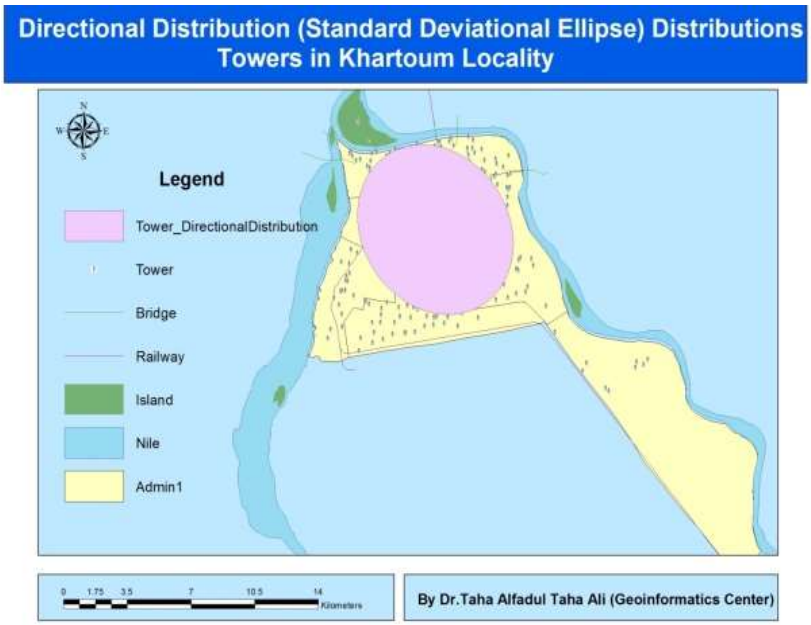


Figure 1 : Cellular phone towers Map in Khartoum north administrator.

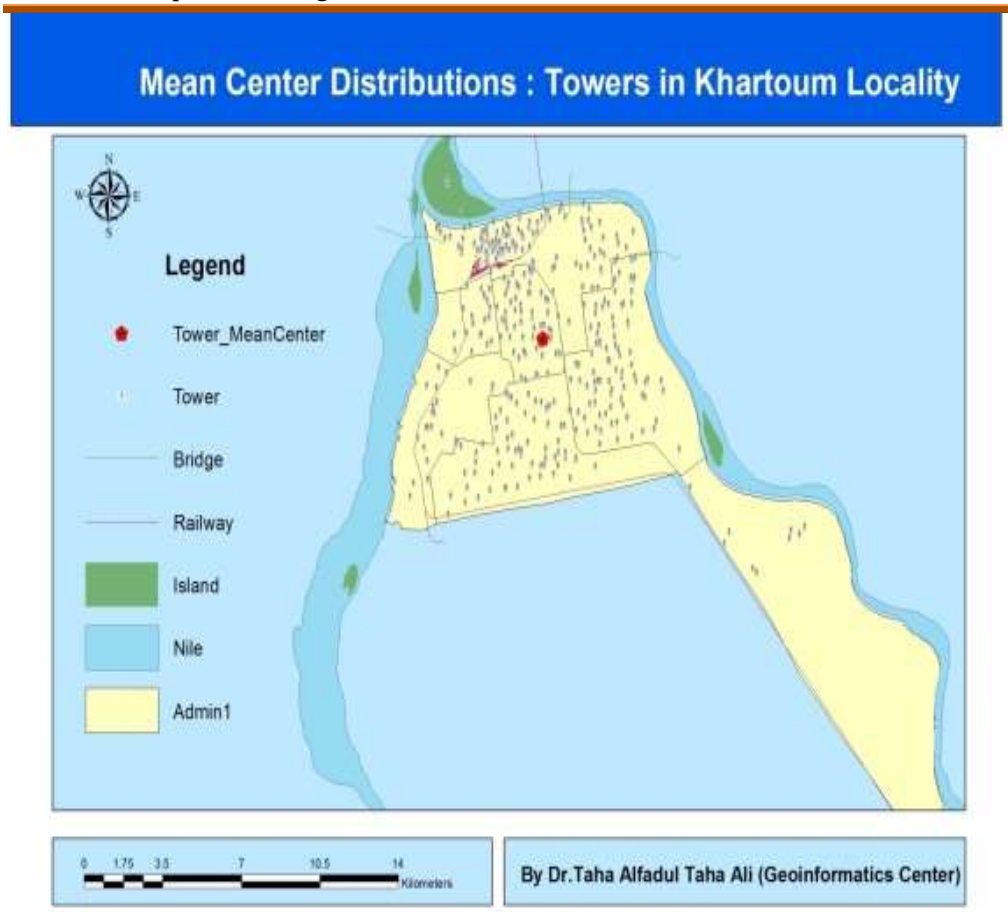
- Central Feature: Identifies the most centrally located feature in cellular towers in Khartoum.

The following illustration identifies the most centrally located distribution cellular towers; the output feature class for this analysis would contain one extracted record: the (Building Roof) that is most central.

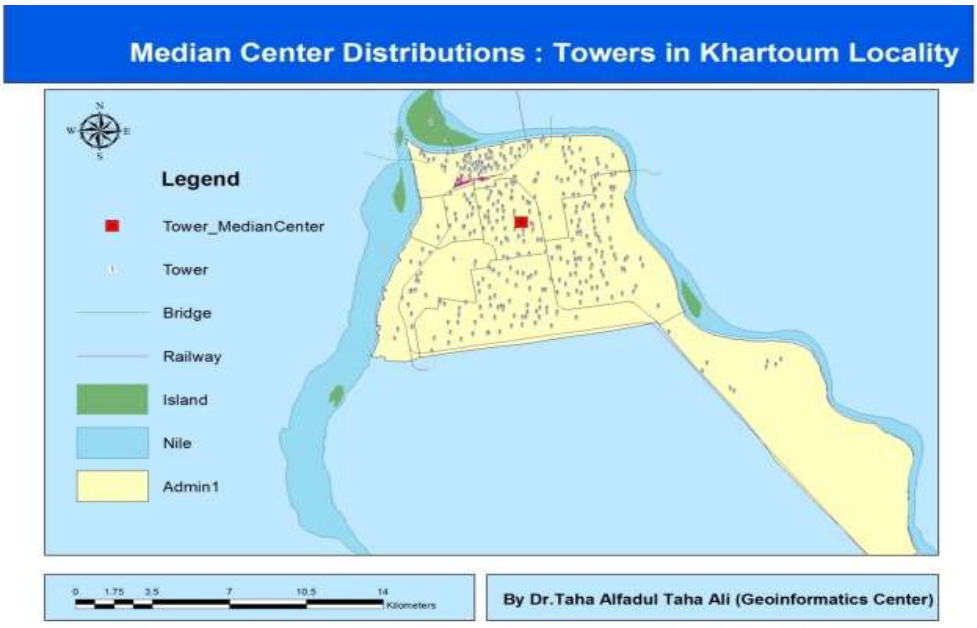
- Directional Distribution (Standard Deviational Ellipse)
  Creates standard deviational ellipses to summarize the spatial characteristics of geographic features: central tendency, dispersion, and directional trends.



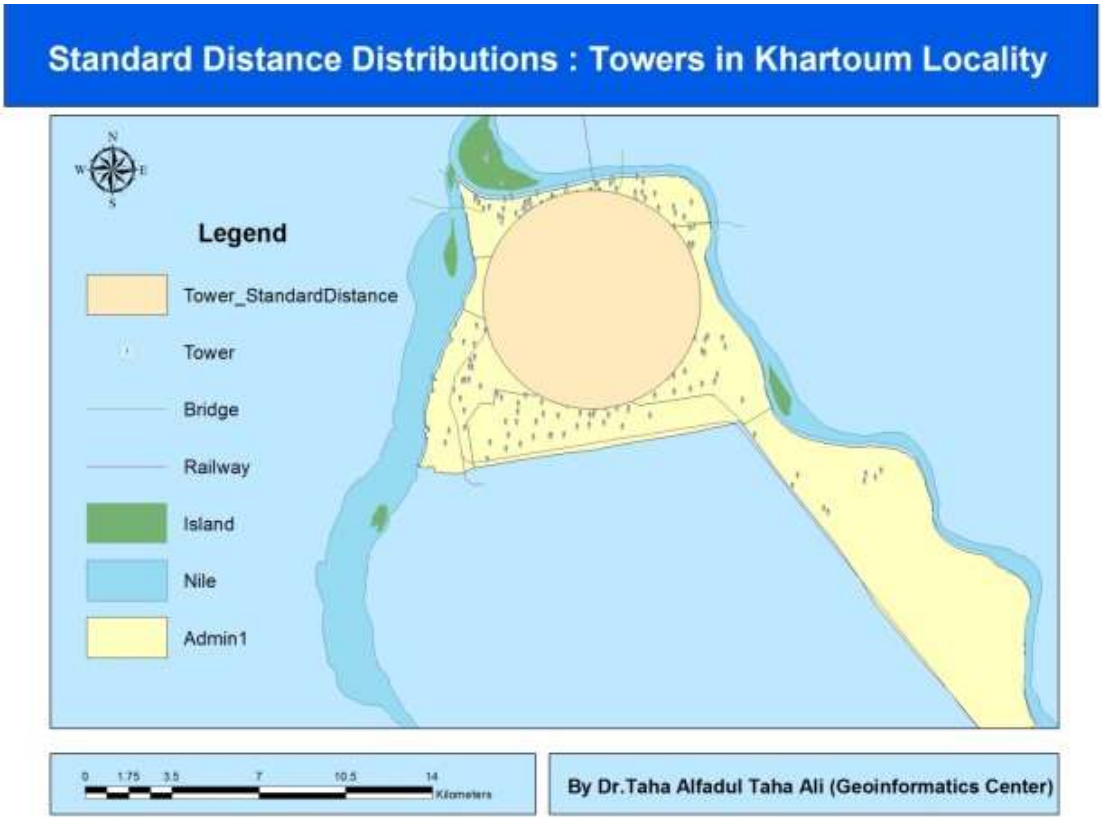
- Mean Center



- Median Center



- Standard Distance



4. CONCLUSION

There are 226 Towers in Khartoum Locality: 90 Towers(in Khartoum East), 19 Towers(in Khartoum west), 19 Towers(in Khartoum Central), 78 Towers(in Khartoum Soba), 10 Towers(in Khartoum Al-shagrah). Hug Towers impacts for our life's. in addition to measure Geographic Distributions Cellular Phone Towers in Khartoum, identify, create, and measure Central Feature, Directional Distribution, Mean Center, Median Center and Standard Distance for Towers

5. ACKNOWLEDGMENT

The work is supported by GeoFive Sustainable Renewable Energy (GSRE).

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