



# **A developed Numerical Mapping Technique**

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## **Abstract**

An automated mapping technique for representing the hourly behavior of the ionosphere was presented by Rush in 1976, the technique is based on updating the predicted monthly median maps of ionospheric parameters with hourly observations. The procedure was accomplished by computing the differences between the predicted medians and the hourly values of ionospheric parameters that are observed at specific locations on the globe. This technique provides the basis for extending and extrapolating the influence of an observation from the observing location to the region surrounding the observing location this method is very complicated, so we used in our research another new developed method. The designed and implemented program in our work for a new mapping technique method was suggested and used to draw the maps based on updating the monthly median of ionospheric parameters predicted with geographic coordinates.



## Introduction

The technique presented by Rush in 1976 which is based on updating the monthly median maps of ionospheric parameters with hourly observations by computing the differences between predicted median and the hourly observed values at specific location. This technique provides the basis for extending and extrapolating the influence of an observation from the observing location to the region surrounding the observing location this method is very complicated, so we used another new developed method which is consists of the following steps

1- Read data (latitude  $\theta_i$ , longitude  $\varphi_i$ , ionospheric parameter  $V_i$ )

2- Set grid map steps ( $\theta_{stn}$ ,  $\varphi_{stn}$ ) in latitude and longitude respectively

3- Determine the coverage extent, i.e. the minimum and maximum values for latitude ( $\theta_{min}$ ,  $\theta_{max}$ ), longitude ( $\varphi_{min}$ ,  $\varphi_{max}$ ), and the range of ionospheric parameter  $V$  (i.e.  $V_{min}$ ,  $V_{max}$ )

4- Set  $\theta = \theta_{min}$

5- Set  $\varphi = \varphi_{min}$

6- Find the nearest left-top sample data  $(\theta_k, \phi_k)$  to the point  $(\theta, \varphi)$ , then set

$$\theta'_1 = \theta_k \quad ; \quad \phi'_1 = \phi_k \quad ; \quad V'_1 = V_k$$

7- Find the nearest right-top sample data  $(\theta_j, \phi_j)$ , and set

$$\theta'_2 = \theta_j \quad ; \quad \phi'_2 = \phi_j \quad ; \quad V'_2 = V_j$$

8- Find the nearest left-bottom sample data  $(\theta_m, \phi_m)$ , and set

$$\theta'_3 = \theta_m \quad ; \quad \phi'_3 = \phi_m \quad ; \quad V'_3 = V_m$$

9- Find the nearest right-bottom sample data  $(\theta_n, \phi_n)$ , and set

$$\theta'_4 = \theta_n \quad ; \quad \phi'_4 = \phi_n \quad ; \quad V'_4 = V_n$$

10- Determine the distances ( $D_i$ ) between the point  $(\theta, \varphi)$  and  $(\theta'_i, \phi'_i)$  for  $1 \leq i \leq 4$

11- Determine ( $V$ ) by using the formula, 
$$V = \frac{\sum_{i=1}^4 V'_i D_i}{\sum_{i=1}^4 D_i}$$

12- Set the point  $(\theta, \varphi)$  with value  $V$

13- Set  $\varphi = \varphi + \varphi_{stn}$

14- If  $\varphi \leq \varphi_{max}$  then goto step (5)

15- Set  $\theta = \theta + \theta_{stn}$

16- If  $\theta \leq \theta_{max}$  then goto step (4)

17- Stop the algorithm

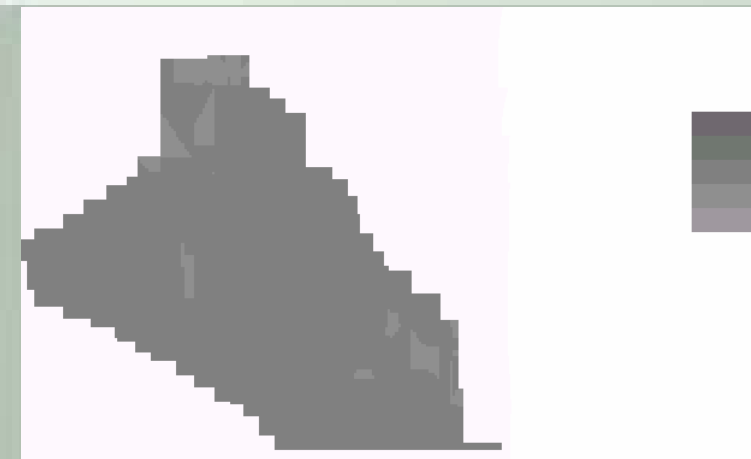
## **Results and Analysis**

### **Variation of Received HF-Field Strength Intensity**

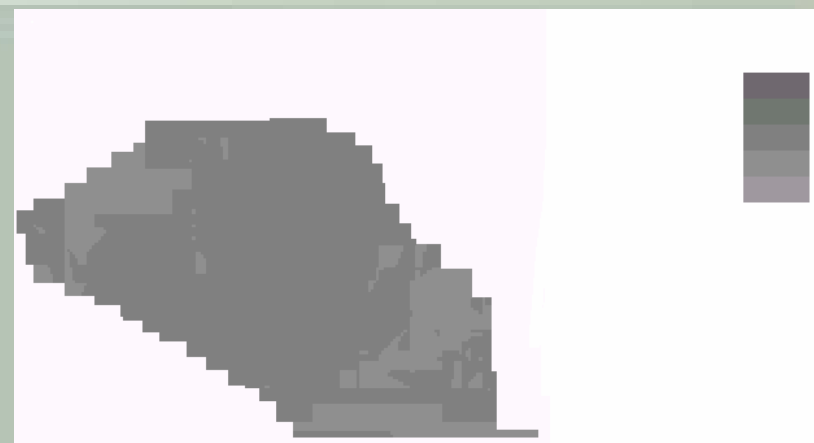
A large amount of data collected from 81 stations distributed along Iraq region from North to south between  $39^{\circ}$  E and  $48^{\circ}$  E,  $30^{\circ}$  N and  $37^{\circ}$  N were used to describe the HF-communication links.

The data are collected within the time period (October of 2001 through May of 2002)

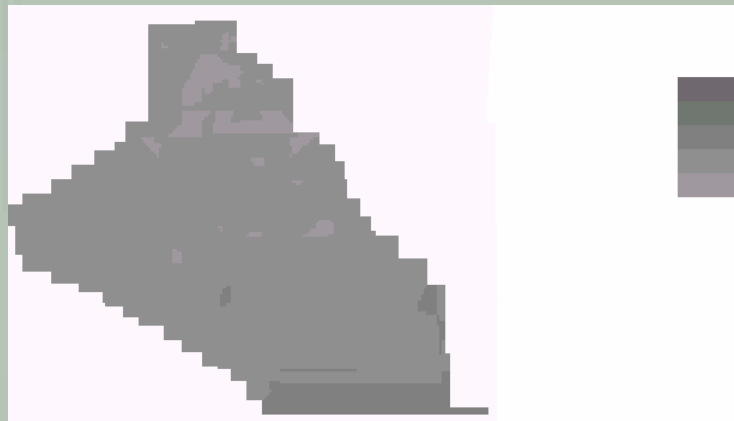
By using the suggested mapping technique (which is discussed above) the map for the February 2002 monthly median field strength values with their geographic coordinates is drawn



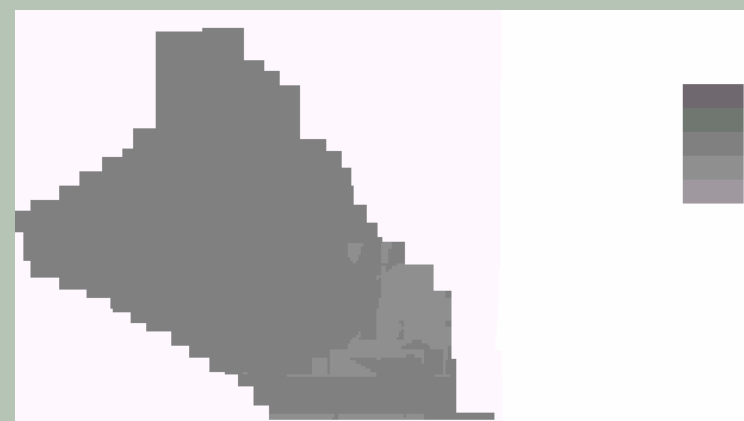
February of 2002 monthly median field strength with geographic coordinates at sunrise (LT=6)



February of 2002 monthly median field strength with geographic coordinates at sunset (LT=18)



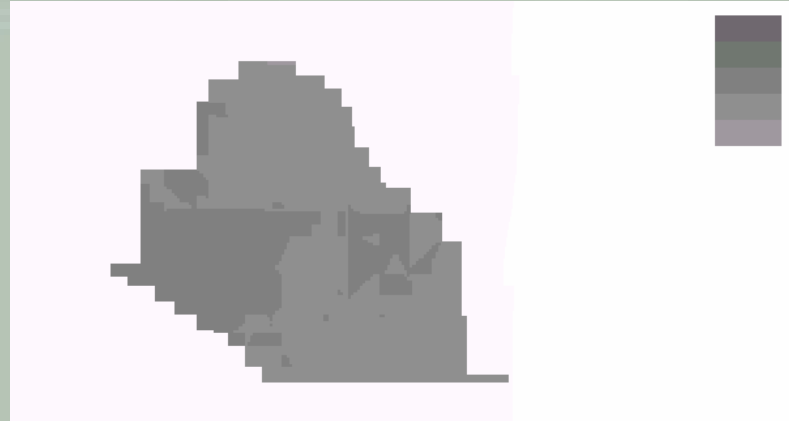
February of 2002 monthly median field strength with geographic coordinates at midday (LT=12)



February of 2002 monthly median field strength with geographic coordinates at mid night (LT=00)



October of 2001 monthly median field strength with geographic coordinates at sunrise (LT=6)



October of 2001 monthly median field strength with geographic coordinates at sunset (LT=18)



October of 2001 monthly median field strength with geographic coordinates at midday (LT=12)



October of 2001 monthly median field strength with geographic coordinates at midnight (LT=00)

A decorative border of red carnations and green vines on a blue background. The carnations are arranged in clusters at the top and bottom corners, with green vines winding around them. The background is a gradient of blue, lighter at the bottom.

Thanks for your  
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