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ABSTRACT

The total electron content ($\bar{I}$) which corresponds to per unit area was computed. This computation was made for the subpeak values of the electron content. Meanwhile the main goal of this study was to calculate the time delay of the e.m.w. (electro magnetic wave) instead of MUF (Maximum Usable Frequency) for long distance communications. At the same time, the monthly median ionograms have been obtained from the measuring period of 1963-1971 and these ionograms were analyzed.

Total electron densities were found with the curves of real height-electron contents by computing from the ten standard points method. ($\bar{I}$) values were analyzed according to the seasonal, annual and different sunspots, then, the differences has been made clear with their coefficients.

1. INTRODUCTION

Figure 1 a, b represents the equivalent curve set as fixed values of True height Frequency contour plottings. The ionospheric data have been collected from the vertical incidence Ionosonde of Istanbul University which is mounted in Istanbul Ionospheric Research Station known as "IIAI" (geomagnetic coordinates; 38° 40' N; 107° 76' E) during the sunspot cycle, number 20, 1963 to 1970 solar activity interval which includes a minimum (1964) and a maximum (1968) as well.

Figure 1a shows the daytime LT 1200 hour having much more critical frequency (MHz) values on the vertical axis for lower altitudes (km) versus monthly time variation as given on the horizontal axis.

Thus, for the fixed values of the true heights the ionospheric profiles over Istanbul have been started by 120 km altitude level and for every after 20 km height the process has been repeated.

Figure 1b shows the nighttime LT 0000 hour having lesser critical frequency values (MHz) on the vertical axis for lower altitudes which was started to commence with 280 km altitude level of the height for the ionosphere as selected.

It can be noted that, during summer months, always at lower altitudes (i.e.150 km), even if the frequency shows an immediate increase but looking at higher altitudes (i.e. 240 km) the frequency shows a decrease nonetheless. From Fig. 1b it can be put as a rule that for a fixed altitude (such as 280 km) the frequency variations are always tending to show a decrease during June months, and the importance of this decrease nearly always gains less steepness by the increasing altitudes (km). For example, for the summer months of the year 1966 if we consider the frequency decrease on the altitudes of 280 km, somehow, it is quite controversial for the 310 km altitudes while there is a frequency increase in general. Moreover, it can be noted that existed frequency variations on the altitudes of 300 km are not as much pronounced as at the altitude of 360 km during the year 1968 presenting the ionospheric pattern of maximum solar activity.

In this study ($\bar{I}$) total electron concentrations have been computed from the real height electron density profiles using standard ten points method (3).

2. $\bar{I}$, Subpeak Electron Content

The Figure 2 shows the change of subpeak electron content $\bar{I}$ which is the total electron number density over the earth surface to subpeak 1 cm^2. The values of subpeak electron content $\bar{I}$ has been obtained by a numerical integration after having true height profiles. However, the true height profiles can be obtained using virtual height by using several methods such as (1), (2), (3), (4), (5) or (6).

In this study 10 points method has been selected because of its simplicity (4), (3). And, the true height frequency variations have been computed using 10 points method, after collecting median ionograms considering LT 1200 and LT 0000 hours consequently (Fig.1a, Fig.1b).

Figure 1a, b shows the true heights dependence of the frequencies being computed from monthly medians of the years 1963 to 1970. Where the months are presented on the horizontal axis and frequencies by vertical axis.

Figure 2a, b shows $\bar{I}$, the computed subpeak electron content values from monthly median ionograms both for the daytime and nighttime hours by LT 1200 and LT 0000 respectively.

The obtained response plotted by (+) signs, gives the average values of the 12 monthly moving median. Where the months are represented on the horizontal axis and the total electron content by the vertical axis.

According to the observed results there exist a correlation between $\bar{I}$ subpeak electron content value of the ionosphere and R Zurich Sunspot Numbers which is as follows,

$$\bar{I} = 2{,}83\ (1 + 0{,}073\bar{R}).\ 10\ \text{els/cm}$$

3. Method and results

In order to be able to determine the yearly, seasonal etc. variations of $\bar{I}$, a method of analysis has been applied (Figure 3). The power spectrum results are not as much satisfactory to observe the effective harmonic for the daytime. But even if ambiguously it is possible to notice the semi annual variation. Considering the auto correlation results (Fig.4) which are not sufficient to observe the recurrence time, however, it can be cited that solely the 12 monthly and 6 monthly recurrence time is pronounced during the daytime period. On the other hand, during the nighttime the auto correlation function shows a maximum connected with the 12 monthly recurrence (Figure 3). From Figure 4, the existence of the 12 monthly harmonic is possible to notice.

After the filtration of the $\bar{I}$ variation, it can be seen that the amplitude of 12 monthly variation has a value of approximately 2 x 10^{12} els/cm^2 (see Fig. 5a). Figure 5b shows the amplitudes of 12, 6 and 4 monthly variations. But, the 3 monthly harmonics have been ignored from as is mentioned in the same figure.

The foF2 (MHz) critical frequency values of F2 layer have lesser numerical readings during summer months versus winter months (summer anomaly). This figures are quite pronounced in Figure 1 a,b. But considering the analysis results as are shown in Figure 5 a,b, it should be kept in mind that the phenomenon has no effective action on the electron density profiles which are concentrated under the heights where the maximum electron concentrations are formed.

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CAPTIONS OF THE FIGURES

Fig. 1- The equivalent curve set as fixed values of Real height (km) Frequency (MHz) contour plottings vs months.

Fig. 1a- The daytime(LT 1200 hr.),Fig.1b The nighttime(LT 0000 hr.).

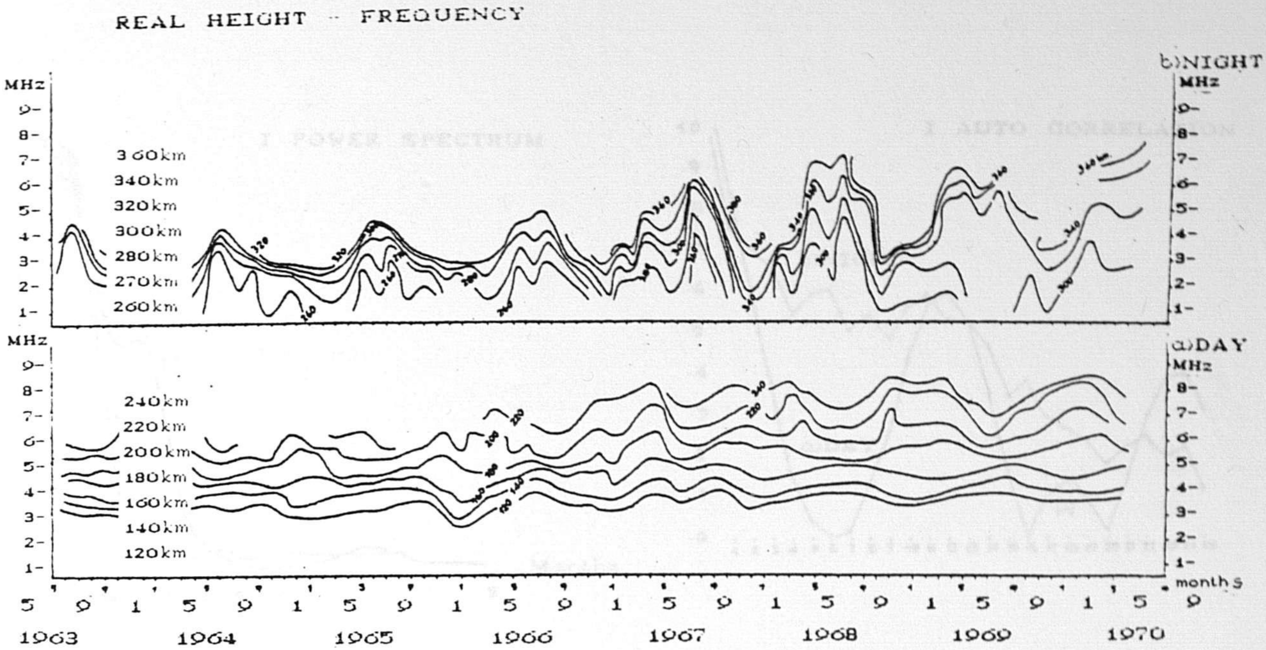
Fig. 2- The change of subpeak electron content $\bar{I}$.

Fig. 3- Power Spectrum of the $\bar{I}$ subpeak electron content value of the ionosphere.

Fig. 4- Auto correlation of the $\bar{I}$ subpeak electron content value of the ionosphere.

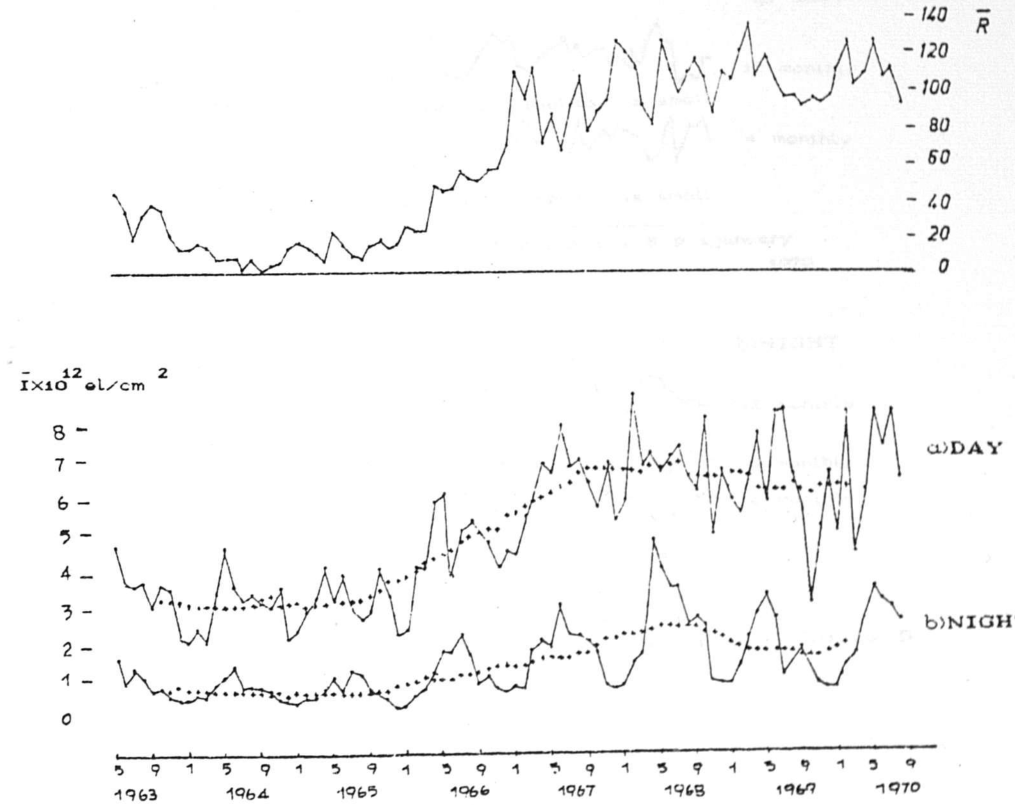
Fig. 5- The amplitudes of various monthly $\bar{I}$ variations and filtration.

Fig. 5a- Daytime(LT 1200 hr.), Fig. 5b Nighttime(LT 0000 hr.).



REAL HEIGHT - FREQUENCY
b)NIGHT
MHz
360km
340km
320km
300km
280km
270km
260km
a)DAY
MHz
240km
220km
200km
180km
160km
140km
120km
months
1963
1964
1965
1966
1967
1968
1969
1970

FIG. 1.



$\bar{R}$
$\bar{I}$x10^{12} el/cm^2
a)DAY
b)NIGHT
1963
1964
1965
1966
1967
1968
1969
1970

FIG. 2.

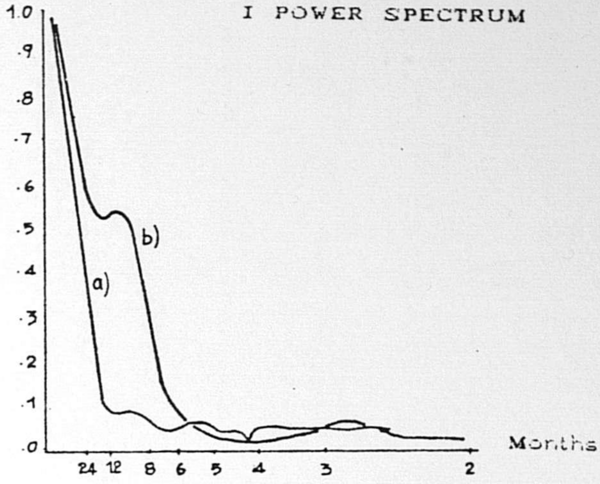


FIG. 3.

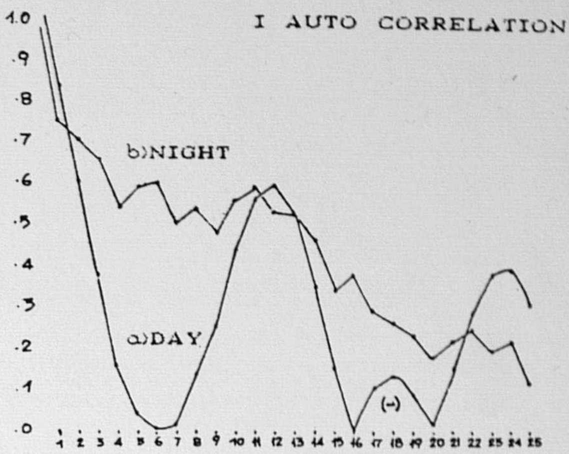


FIG. 4.

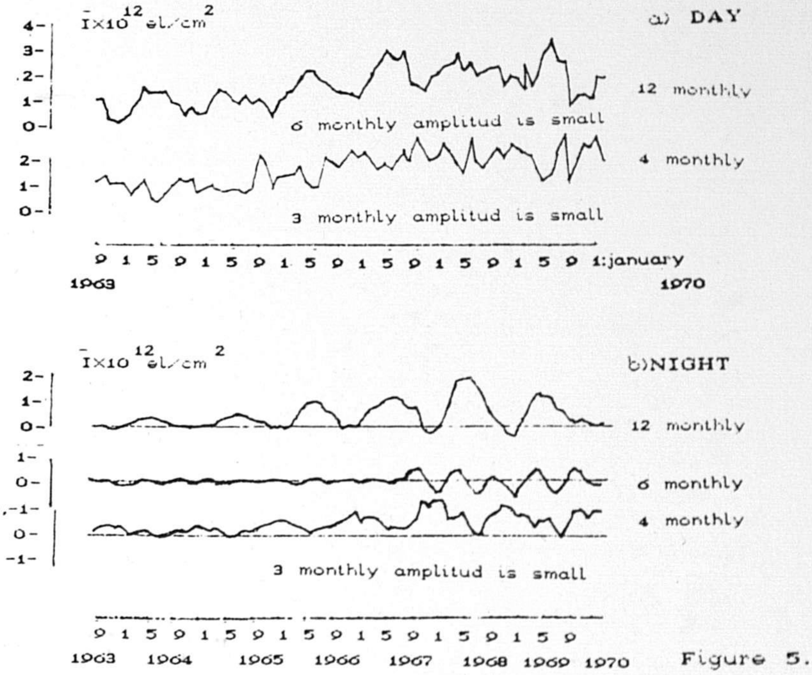


FIG. 5.