

# OBSERVED RELATIONSHIPS AMONG SOME IONOSPHERIC $F_2$ LAYER PARAMETERS IN AN EQUATORIAL STATION.

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## ABSTRACT

Relationships among some  $F_2$  parameters is studied. The parameters are the fading rates of echoes from  $F_2$  layer, the height of maximum  $F_2$  layer,  $h_m F_2$ , critical frequency,  $f_o F_2$  and the maximum useable frequency factor for a distance of 3000km,  $M(3000)F_2$ .  $M(3000)F_2$  is also known as propagation factor. While a fair inverse relationship is observed between  $M(3000)F_2$  and  $h_m F_2$ ; between  $h_m F_2$  and  $f_o F_2$  and and between  $f_o F_2$  and fading rates, a small direct or no relationship is observed ( $M(3000)F_2$  and  $f_o F_2$  and between  $h_m F_2$  and fading rates.

## 1.0

### INTRODUCTION

It is desirable to know the kind of relationship that exists among  $F_2$  layer parameters. This is because the data of some of these parameters are difficult to generate owing to lack of equipments. If the relationships between parameters whose data are not difficult to generate and those whose data are difficult to generate is known, prediction of data of parameters difficult to generate may be possible.

The data of parameters such as  $f_o F_2$ ,  $h_m F_2$ ,  $M(3000)F_2$  are readily obtainable in ionospheric bulletins. This is not the case with those of fading rates in which the fading records from which they can be obtained require expensive and unavailable equipments.

### ANALYSIS

Fading records used to obtain fading rates and ionospheric bulletin from which  $M(3000)F_2$ ,  $h_m F_2$  and  $f_o F_2$  median values are obtained, were collected from the ionospheric observatory at Ibadan. 1200 (LMT) median values of 1958 (a year of high sunspot number) months for the four parameters are used. Median values are used, being readily available in the bulletins and having been found to show no significant difference from mean values (Somoye, 1984).

Scatter diagrams of  $M(3000)F_2$  and fading rates;  $M(3000)F_2$  and  $h_m F_2$ ;  $M(3000)F_2$  and  $f_o F_2$ ;  $f_o F_2$  and  $h_m F_2$ ;  $f_o F_2$  and fading rates and  $f_o F_2$  and fading rates are shown in Figures 1(a) – (f). The pairs are also correlated.

## 3.0

### RESULTS AND DISCUSSION

The scatter diagrams in Figures 1(a) – 1(f) show that there seems to be

- i. A small direct relationship between  $M(3000)F_2$  and fading rate
- ii. A fairly high inverse relationship between  $M(3000)F_2$  and  $h_m F_2$ .
- iii. A small direct relationship between  $M(3000)F_2$  and  $f_o F_2$ .
- iv. An average inverse relationship between  $f_o F_2$  and  $h_m F_2$ .
- v. An average inverse relationship between  $f_o F_2$  and fading rate
- vi. A very small direct relationship between  $h_m F_2$  and fading rate

Correlation coefficients corresponding to the pairs of (i)  $M(3000)F_2$ /fading rate is 0.17;

(ii)  $M(3000)F_2$  /  $h_m F_2$  is  $-0.65$ ; (iii)  $M(3000)F_2$  /  $f_o F_2$  is 0.23; (iv)  $f_o F_2$  /  $h_m F_2$  is

$-0.45$  (v)  $f_o F_2$  / fading rate is  $-0.4$  and (vi)  $h_m F_2$  / fading rate is 0.04

Explanation for the inverse relationship between  $f_o F_2$  and fading rate may be sought from the relation

$$\frac{\Delta f}{f_o F_2} \approx \frac{\Delta N}{N}$$

Where  $\Delta f$  is the range of frequency in the spreading of f region echoes caused by spread f irregularities.  $\Delta N$  is the deviation in N or electron concentration also called irregularities. The drift and changing in form of irregularities cause fading of echoes (Somoye, 1996; Bamgboye, 1969; Onolaja, 1977; Morriss and Lyon, 1966 and Skinner et al., 1966). That an inverse relationship is observed to exist between  $foF_2$  and  $hmF_2$  follows from the fact that when  $hmF_2$  is raised irregularities are enhanced (Martyn, 1959) and fading rate should be high.

$M(3000)F_2$  is expected to show an inverse relationship with  $foF_2$  since

$$M(3000)F_2 = \frac{MUF}{foF_2}$$

(MUF) being maximum useable frequency. Their correlation coefficient is 0.23.

The average inverse relationship between  $M(3000)F_2$  and  $hmF_2$  shows that as the height of maximum  $F_2$  layer is raised,  $M(3000)F_2$  decreases and MUF is enhanced.

The relationship between  $M(3000)F_2$  and fading rate, though direct is small.

As  $hmF_2$  increases, which is the case during a period of high sunspot number fading rate is expected to be high since irregularities whose drift and changing in form cause fading is enhanced. The scatter diagram (see Figure 1(f)) and the correlation coefficient of 0.04 show nothing but a very small direct relationship between them.

#### 4.0 CONCLUSION

A fairly high inverse relationship is observed between  $M(3000)F_2$  and  $hmF_2$ . Average inverse relationships are also observed between the pair of  $foF_2$  and  $hmF_2$  and between the pair of  $foF_2$  and fading rate. The other pairs show little direct relationship or no relationship at all

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