Journal of Research and Review in Science Vol 2. November 2001. pp. 48-50

E - LAYER AT IBADAN - A CHAPMAN LAYER?

C .O. OGABI AND E.O. SOMOYE

Dept. of Physics, Lagos State University, Ojo, Lagos.

ABSTRACT

The chapmanlike nature of ionospheric E. layer at Ibadan is investigated using the critical frequencies of E region, f_oE, data obtained to be 0.28 for December 22, 1957; 1.9 for March 21, 1958; 0.28 for June 22, 1958 and 0.1 for September 22, 1958. These results indicate that E layer at Ibadan approximates a chapman layer during the solstices but not during the equinoxes.

1.0 INTRODUCTION

It is known that the critical frequency fo, of a layer is proportional to the solar zenith angle χ . Many investigators assume a relation of the type.

$f_o \propto (\cos \chi)^n$ (-1)

and proceed to find the value of n as χ varies with latitude for a number of stations. The solar zenith angle, χ, also varies diurnally and seasonally.

The diurnal variation of χ can thus be used to investigate the chapmanlike nature of a layer. For a Chapman layer, the index n in the relation above should be 0.25 or thereabout. This investigation is carried out for the E layer at Ibadan in what follows below.

2.0 ANALYSIS AND RESULTS

The data used are those of the critical frequencies, f_oE, of December 22, 1957; March 21, 1958; June 22 1958; and September 22, 1958; the December solstice, March equinox, June solstice and September equinox respectively, obtained at the Ibadan observatory.

Diurnal variation of f_oE with χ, the sun's zenith angle for the solstices and the equinoxes are illustrated in figures (1) -- (4).

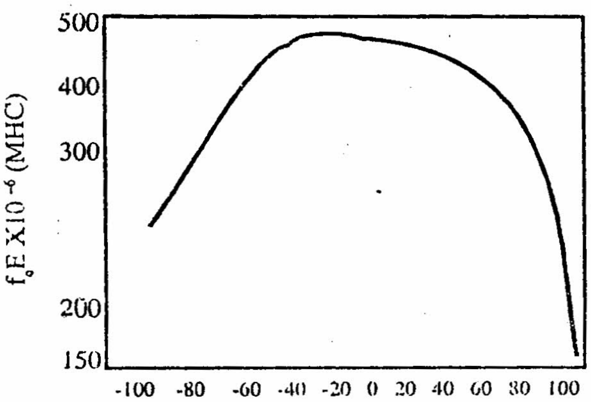

Fig. 1 Variation of f_oE with χ for December, 1957

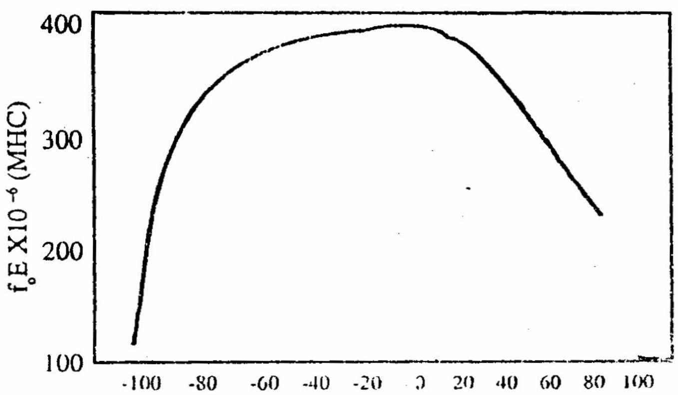

Fig. 1 Variation of f_oE with χ for June, 1958

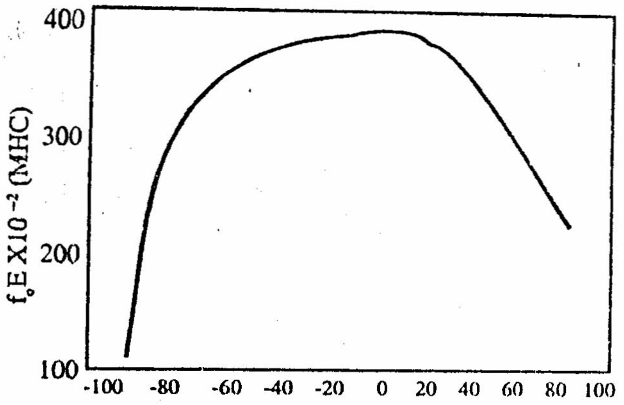

Fig. 4 Variation of f_oE with χ for September 22, 1958

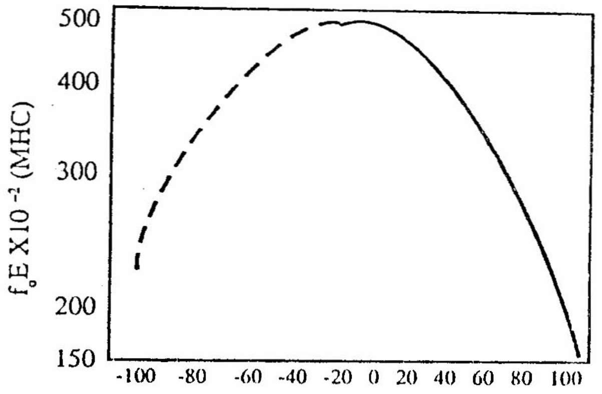

Fig. 2 Variation of f_oE with χ for March 21, 1958

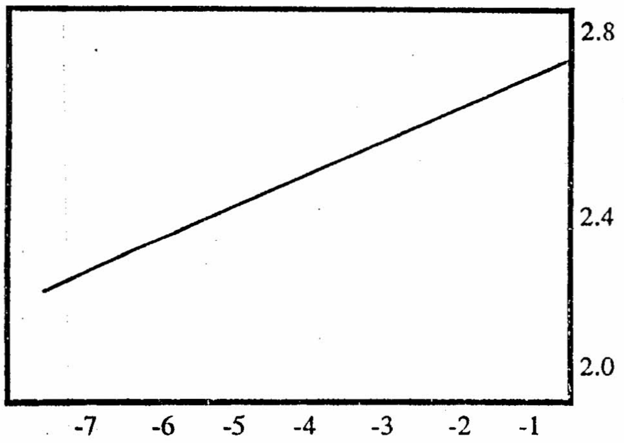

Fig. 7 Variation of Log (f_oE) with log (cos χ)
during Dec. 22, 1958

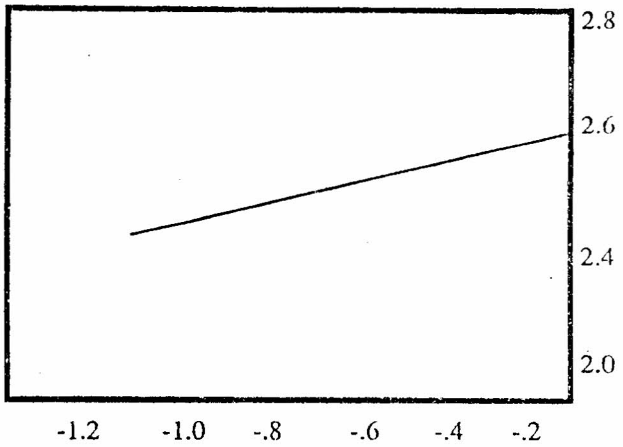

Fig. 7 Variation of Log (f_oE) with log (cos χ)
during June 1958

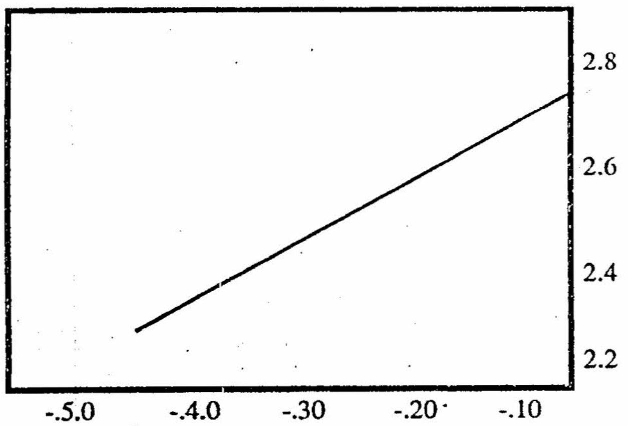

Fig. 6 Variation of Log (f_oE) with log (cos χ)
during March 21, 1958

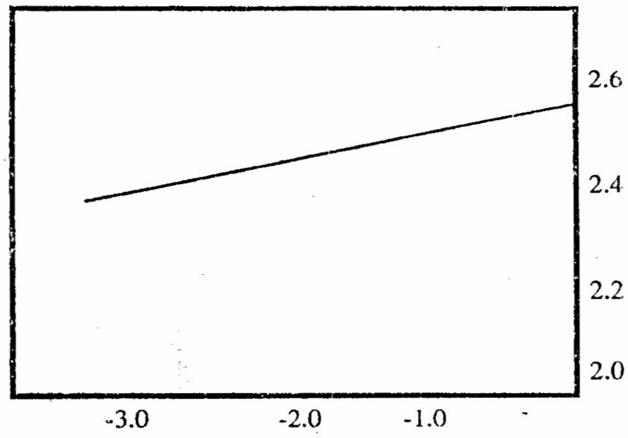

Fig. 8 Variation of Log (f_oE) with log (cos χ)
during Sept. 23, 1958

Empirical analysis is used to determine the index n in equation (1). Equation (1) can be written as

$f_oE \quad = \quad A\,((\cos\chi)^n \qquad - \qquad (2)$

Where A is a constant

Taking logarithms, equation (2) becomes

$\log f_oE = \quad A + n \log \cos \chi$

The variation of $\log f_oE$ with $\log \cos \chi$

is expected to be a straight line if the empirical relation (equation (2) is valid (see figures 5-8). The value of the slope is n and A can be determined from the intercept.

The least square method used in determining n and A from the data yield the results in Table 1.

Table 1

Season	N	log A
December Solstice	.28	2.64
March Equinox	1.89	3.0
June Solstice	.28	2.63
September Equinox	.06	2.54

3. DISCUSSION

From the results in Table 1 the values of index n for December and June solstices are in good agreement with the theoretically predicted value of 0.25. Rishbeth and Garriot (1969) pointed out that the seasonal variation of the frequencies of ionospheric E layer with the zenith angle, χ gives a result closer to the theoretical value unlike the diurnal (Tremellen and Cox 1947) and latitudinal variations. It is interesting to note that the result, quoted by Rishbeth and Garriot, observed at a station, other than an equatorial or low latitude station agrees with present result of a low latitude station of Ibadan during the solstices.

Values of the index n obtained for the equinoxes deviate from the theoretical value.

The relationship

$\cos\chi = \quad \sin\phi \; \sin\delta + \cos\phi \quad \cos\delta \cos M$

indicates that the zenith angle, χ depends on δ, the sun's declination, ϕ the latitude of the observer, north of the equator and M the month angle of the sun from the observer meridian westwards to the meridian through the sun from O^M to 12^M or O^0 to 360^0. the sun's declination is however known to have stationary values only at the solstices. This may be responsible for the close approximation of E layer at Ibadan does not approximate Chapman layer during the equinoxes may be due to the changing declination of the sun during these periods.

REFERENCES

Rishbeth and Garriot, Intro. to Iono. Phy., A.P. New York p. 165 , 169.

Tremellen, K.W and J.W. Cox Influence of wave propagation on planning of short – wave communication, Proc. Inst. Elect. Eng. 94 – IIIA, 200 – 219, 1949.