COMPARISON OF THE VARIABILITY OF SOME IONOSPHERIC PARAMETERS AT A LOW LATITUDE AND A HIGH LATITUDE STATIONS DURING MODERATE SUNSPOT NUMBERS

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INTRODUCTION

Ionospheric characteristics at the equatorial and low latitude stations are known to differ from those in other stations of high latitudes. This is not unconnected with the geomagnetic activities of the earth, which vary latitudinally. For instance, whereas the magnetic field is almost transverse at the equatorial region, at the pole and high latitudes it is longitudinal.

In this study the variability of ionospheric parameters such as the critical frequencies of E- and F_2 layers (foE and foF) and the virtual height of reflection of radio signals for Ibadan (3^0S) and for Halley Bay (-65^0S) during 1971 is reported.

METHOD

Three widely used methods of variability are those defined by (i) Schumann and Mostert (1949) and called Relative Variability (V_r), (ii) Katshelson and Kotz (1957) and called relative inter-sequential variability (V_s) and (iii) Coefficient of variation (C_v).

Relative Variability is the ratio of mean deviation to the arithmetic mean i.e.

$$V_r = \frac{n}{n-1}\frac{\sum|(X_i)-(X_i+1)|}{\sum X_i}$$

Coefficient of variation, C_v, is the ratio of standard deviation to the arithmetic mean i.e.

$$C_v = \frac{s}{\bar{X}}$$

X represents the variates, $\bar{X}$ the mean of the variates and s the standard deviation.

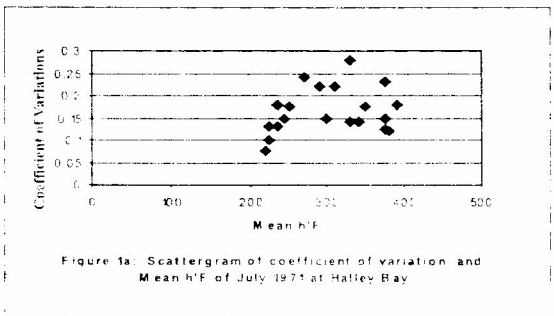

Figure 1a: Scattergram of coefficient of variation and Mean h'F of July 1971 at Halley Bay

The measure of variability used here is that of coefficient of variation, C_v.

The coefficient of variation is calculated for all parameters mentioned in section 1.0. A scatter of C_v on the mean of the variates of each parameter is then shown in Figures 1 - 3.

RESULTS

Values of coefficient of variation for f_0E seems higher at Halley Bay than at Ibadan, the range being 0.04 to 0.43 at the former and 0.02 to 0.13 at the latter. At Ibadan variability of f_0E seems inversely proportional to f_0E while it appears slightly directly proportional at Halley Bay. See Figures 2a and 2b. The correlation coefficient being 0.84 and 0.38 respectively.

For f_0F_2 the range of coefficient of variation at Ibadan is 0.05 to 0.26 while it is 0.12 to 0.56 at Halley Bay though the Ibadan station records higher mean values of f_0F_2. the variability of f_0F_2 seems inversely proportional to f_0F_2 mean values at Ibadan, while there seems not to be any relationship between variability of f_0F_2 and f_0F_2 mean values.See Figures 3a and 3b. The correlation coefficients of 0.81 and 0.05 for Ibadan and Halley Bay respectively, lend credence to these assertions.

The ranges of coefficient of variation for hF are about the same for both stations though ranges of value of h'F for both stations are a little different being about 218 to 396km for Halley Bay and 200 to 315km for Ibadan. The variability of h'F at Ibadan seems to be directly proportional to virtual height while that of Halley Bay, though slight is also directly proportional to virtual height. See Figures 1a and 1b. The correlation coefficient of both stations, respectively are 0.82 and 0.37.

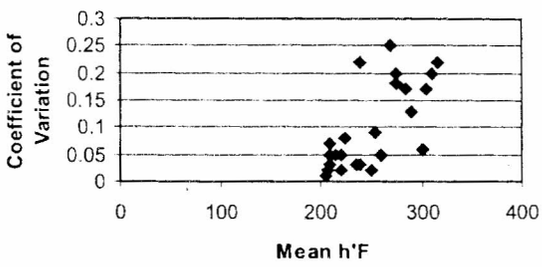

Figure 1b: Scattergram of coefficient of variation, and Mean h'F of July 1971 at Ibadan.

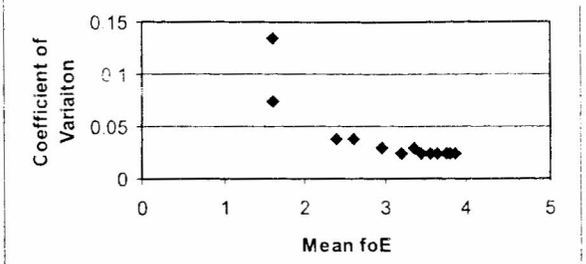

Figure 2b: Scattergram of coefficient of variation, and Mean foE of July 1971 at Ibadan.

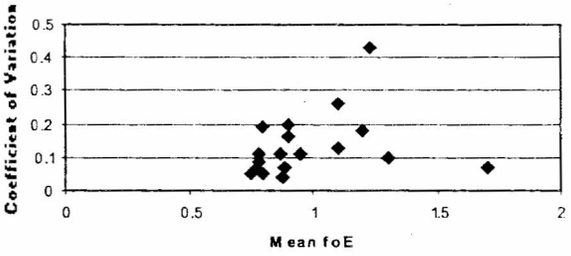

Figure 2a: Scattergram of coefficient of variation, and Mean foE of July 1971 at Halley Bay

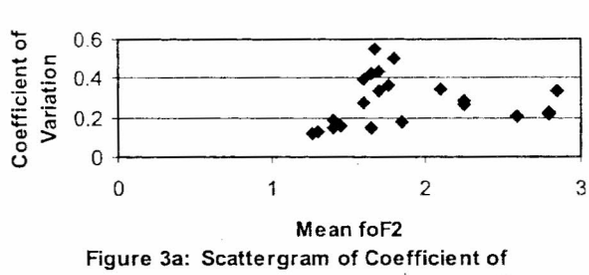

Figure 3a: Scattergram of Coefficient of variation, and Mean foF2 of July 1971 at Halley Bay.

DISCUSSION

Variability is expected to be higher for f_0F_2. F_2 region from where the signals are reflected being more unpredictable than the E region. This result is in fair agreement with that of Somoye (2004) who found that this is the case for all months, except the solsticial and equinox months i.e. June and December, March and April respectively. The data used for this study are those of July 1971. The negative correlation coefficient of f_0E, and f_0F_2 with variability at the Ibadan station shows that variability increases for decrease in the critical frequencies of E and F_2 regions. This is probably due to reduction in intensity of radiation as it is used up by neutral particles in its passage downward, at which time variability increases. Radiation causing ionization might consists of photons in the ultraviolet and X-ray part of the spectrum or of particles, either charged or uncharged. The charged particles would be deflected towards the poles the earth's magnetic field (Ratcliffe, 1970). The foregoing implies that charged particles whose intensity may not wane are also responsible for ionization at high latitudes. This may be responsible for the difference in the relationship between variability of f_0E and f_0F_2 with the mean values of f_0E and f_0F_2 for both stations.

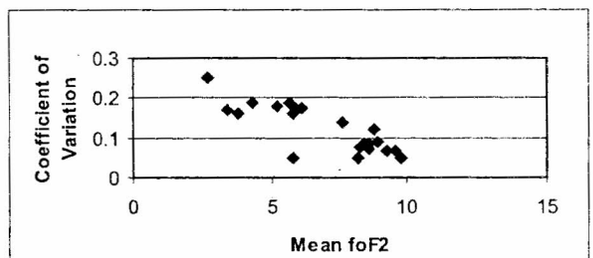

Figure 3b: Scattergram Coefficient of Variation, and Mean foF2 of July 1971 at Ibadan.

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