CHAPTER II

CORRELATION BETWEEN THE IONISATION ANOMALY STRENGTH AND THE ELECTROJET STRENGTH

II.1 INTRODUCTION

Two ionospheric phenomena occurring at the equatorial magnetic latitudes are 1) the ionisation anomaly and 2) the electrojet. The equatorial ionisation anomaly is the name given to a feature of the latitudinal distribution of electron concentration in the F-region showing two well defined peaks at 15-20° dip latitudes with a prominent trough at the magnetic equator. The anomaly was discovered in the latitudinal distribution of foF2 by Appleton (1946). King et al. (1964), and Eccles and King (1969) found the phenomenon to extend into the topside ionosphere as well.

The equatorial electrojet is a strong eastward current in the E-region (at about 100 km altitude) within a narrow zone of $\pm 3^\circ$ dip latitude during the daylight hours (Chapman, 1951, 1956). The strong electrojet current is shown to be responsible for the observed large diurnal range of the geomagnetic H field at stations near the magnetic equator (Egedal 1947, 1948; Pramanik and Hariharan 1953).

The common cause for the existence of both the ionisation anomaly and the electrojet is understood to be the eastward electric field ($\mathbf{E}$) which interacts with approximately horizontal magnetic field ($\mathbf{B}$) and exerts $\mathbf{E} \times \mathbf{B}$. 

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force on the plasma. In the F-region as well as the topside ionosphere, the ion and the electron gyrofrequencies are greater than their respective collision frequencies with the neutral particles with the result that ions and electrons drift together with the Hall drift velocity, \((E \times B)/B^2\).

The plasma thus lifted up, diffuses downward along the earth's magnetic field lines giving rise to the peaks of anomaly on either side of the equator (Martyn, 1947; Rastogi, 1959; Duncan, 1960). This process termed as "Martyn's Fountain Theory" explains satisfactorily most of the observed features of the ionisation anomaly (Bramley and Peart, 1965; Hanson and Moffett, 1966).

In the E-region, around 100 km altitude, the electron gyrofrequency greatly exceeds the electron-neutral collision frequency but the ion gyrofrequency is less than the ion-neutral collision frequency. Under these circumstances the electrons move under the influence of \(E \times B\) force whereas the ions remain unaffected. For a location at a dip angle \(I = \pm 5^\circ\) the vertical Hall currents are greatly inhibited, and more so at the magnetic equator (\(I = 0\)). The inhibition of vertical Hall current leads to vertical Hall polarisation electric field which is \(\sigma_2/\sigma_1\) \((\sigma_2 \approx 30 \text{ at } 100 \text{ km altitude at the equator; Sugiura and Cain, 1966})\) times the primary eastward electric field \((E)\), \(\sigma_1\) and \(\sigma_2\) are the Pedersen and the Hall conductivities respectively. More recently
Anandarao et al. (1975) have shown observationally that the vertical polarisation electric field is \( \frac{\sigma_2 \, ds}{\int \sigma_1 \, ds} \) times the primary electric field, where \( ds \) is the line element along the earth's magnetic field line. The vertical polarisation electric field interacting with the northward horizontal \( B \) field produces westward motion of the electrons causing the eastward electrojet current. The current is given by 
\[
\mathbf{j} = \mathbf{\sigma}^3 \mathbf{E},
\]
where \( \mathbf{\sigma}^3 = \frac{\sigma_2^2}{\sigma_1 + \sigma_1^2} \) is termed as the "Cowling conductivity", which greatly exceeds the Pedersen conductivity \( (\sigma_1) \) in the equatorial \( E \) region (Baker and Martyn, 1952, 1953). From the above description it is apparent that the electric field is the cause for the ionisation anomaly in the \( F \) region/topside and the electrojet in the \( E \) region. One would naturally expect a close relation between the phenomena caused by the same agency.

II.2 SUMMARY OF EARLIER WORK

The close relation between the electrojet current and the \( F_2 \) layer ionisation near the magnetic equator was pointed out by Rastogi (1963, 1965). He showed that at an equatorial station the seasonal, the latitudinal and the solar cycle variations in the amplitude of lunar tidal variations in the \( f_{oF2} \) and the geomagnetic \( H \) field are very similar to each other and the phases between the two are almost opposite in all the cases. Thus an increase of the electrojet current strength causes a decrease of the \( F_2 \) layer ionisation at the magnetic equator and vice versa.
A quantitative relationship between the two phenomena was first shown by Dunford (1967). He argued that if the Martyn's fountain effect were the cause for the ionisation anomaly, there should be some relationship between the anomaly and the current in the E region (at which level the electric field is impressed). Dunford normalised the published foF2 data at 1300 hr. LT for different stations in the Asian zone by the respective monthly mean foF2 at the same local time. He plotted the normalised foF2 data against the maximum daily range of \( H \) field (\( \Delta H \)) at equatorial station. At Trivandrum (equatorial station) the foF2 showed decreasing trend with increase in the maximum range of \( \Delta H_T \) (suffix 'T' represents "Trivandrum"), whereas the foF2 at stations Delhi and Ahmedabad (stations near the anomaly crest) showed increasing trend with increase in maximum daily range of \( \Delta H_T \). Dunford estimated the eastward electric field from the magnetic range \( \Delta H \) at the equatorial station and concluded that the higher the vertical (\( E \times B \)) drift over the magnetic equator the lower the values of foF2 over the magnetic equator and the higher the values of foF2 at the anomaly crest, in agreement with Martyn's concept of anomaly formation.

Dunford defined a parameter \( S \), given by \( S = W \times D \), to represent the anomaly strength at a fixed altitude (450 km) in the ionosphere. The parameter \( W \) denotes the separation between the latitudes of the anomaly peak and the trough.
The parameter $D$ represents $(N_p - N_t)/N_t$, where $N_p$ and $N_t$ are the electron concentrations at the anomaly peak and trough respectively. The parameters $W$ and $D$ are called the 'width' and the 'depth' of the anomaly, and the quantity $S$ is called the "anomaly product". The quantities used for calculating $W$ and $D$ were obtained from latitudinal distribution of electron concentration at 450 km altitude obtained from Alouette - 1 topside sounder data. Dunford found that the latitudinal structure as well as the crest to trough ratio of the anomaly shows large variations. On some days, $D$ is small while $W$ is large and vice versa. The parameter $S$ minimizes the effect of these variations and hence is a better measure of the anomaly strength instead of either $W$ or $D$ separately. He showed that the anomaly product $S$ obtained on a number of days shows linear relationship with magnetic range at equatorial station Muntinlupa.

Mao Fu Wu (1970) presented a few individual examples of anomaly formation using Alouette-1 satellite data recorded at equatorial station Huancayo and compared the strength of anomaly with the maximum amplitude of the $\Delta H$ field at Huancayo. She found that the days on which the maximum range of $\Delta H$ at Huancayo is large, the anomaly develops prominently and vice versa.
Rastogi and Rajaram (1971) showed that $f_{0}F_{2}$ at the equatorial station Kodaikanal decreases while $f_{0}F_{2}$ at Ahmedabad increases steadily with the increase of equatorial electrojet strength estimated by the difference in the maximum daily range of $\Delta H$ at equatorial station Trivandrum and that at the low latitude station Alibag.

The work of Mao Fu Wu and Rastogi and Rajaram supplemented Dunford's work and provided support to the Martyn's fountain theory of ionisation anomaly formation.

Rush and Richmond (1973) made quantitative investigation of the relationship between the anomaly strength and the electrojet strength using the published $f_{0}F_{2}$ data for American, African, Indian, and Japanese sectors for the year 1958. They defined six parameters for representing anomaly strength: $R_N$, $\phi_N$, $R_N \times \phi_N$, $R_S$, $\phi_S$ and $R_S \times \phi_S$. The parameters are calculated from the latitudinal distribution profiles of $f_{0}F_{2}$. The parameter $R$ denotes the crest to trough ratio of electron concentration and $\phi$ denotes the latitude of the anomaly crest. The suffixes 'N' and 'S' denote the 'northern' and the 'southern' crest of the anomaly respectively. The parameter $\phi$ is same as the parameter $W$ of Dunford (1967) and $R$ is related to the parameter $D$ as $R = (1 + D)$.
Rush and Richmond compared the anomaly strength $S$ with the maximum midday electrojet strength defined by two parameters, $\Delta H_I$ and $\Delta H_{II}$. The parameter $\Delta H_I$ was defined as

$$\Delta H_I = \frac{H_{10} + 2H_{11} + 2H_{12} + H_{13}}{6} - \frac{H_{00} + H_{01} + H_{02} + H_{22} + H_{23} + H_{24}}{6}$$

... ...(1)

where $H_{10}$, $H_{11}$----, say $H_i$ represents the average value of $H$ between $i$ and $(i + 1)$ hr LT at an equatorial station.

$\Delta H_{II}$ was obtained by subtracting similar $\Delta H_I$ at a low latitude station outside the influence of electrojet belt from the $\Delta H_I$ at the equatorial station as calculated by using eq.(1). $\Delta H_I$ and $\Delta H_{II}$ represent the midday electrojet strength. According to these authors $\Delta H_{II}$ represents the midday electrojet strength more closely than $\Delta H_I$ especially during magnetically disturbed period.

Rush and Richmond calculated correlation coefficients between the midday electrojet strength and the anomaly strength and showed that the correlation coefficients tend to maximise in the early afternoon between 1300-1600 hr LT. They pointed out that this time interval is about 2-3 hours after the mean local time at which the midday electrojet strength is calculated and thus this result is consistent with the results obtained by solving the continuity equation for electrons in the F2 region (Sterling et al. 1969; Anderson, 1973), showing
the response of the anomaly to lag about 2-3 hrs behind the changes in the electric field. Fig. 2.1 reproduced from their work shows the diurnal variation of the correlation coefficient between the six anomaly parameters and the electrojet parameter $\Delta H_1$ for the American sector for Oct. 1958. It is seen from the figure that the correlation coefficients decrease in the evening hours and become insignificant after 2000 hr LT. It is also seen that the correlation coefficients decrease steeply between 1400 and 1200 hr LT. At 1200 hr, the correlation coefficients of the electrojet strength with the anomaly parameters $\phi N$ and $\phi S$ show negative values; with the anomaly products $(R_N \times \phi_N)$ and $(R_S \times \phi_S)$ the correlation coefficients are nearly zero. From the trend of the variation of the correlation coefficients with local time we conclude that the correlation of the anomaly strength with the midday electrojet strength prior to 1200 hr LT would either be zero or negative.

We feel that the choice of the electrojet parameter, the midday electrojet strength, taken for comparison with the anomaly strength at all hours of the day by the authors mentioned above, is not proper. The equatorial anomaly develops usually around 08-10 hr LT and thereafter its strength increases with time until about 1400 hr LT in sunspot minimum period and until 2000 hr LT in sunspot maximum period (Rastogi, 1966). The crest to trough ratio of electron
Fig. 2.1: Diurnal variation of the correlation coefficients between six anomaly parameters and electrojet strength ($\Delta H_e$) for Oct, 1958, American sector (after Rush and Richmond, 1973).
concentration as well as the dip latitude of the crest increase continuously, although not monotonically, from the time the anomaly first appears until its maximum development. The continuous build-up of the anomaly suggests that its strength at any particular time should depend upon the time-integrated strength of the electric field starting from the time (around sunrise) when the electric field reverses from westward to eastward direction. The diurnal variation of the electrojet current strength, as revealed by the daily variation of equatorial $\Delta \mathbf{H}$ field, is caused by the diurnal variation of the E region electron concentration as well as the electric field. The electron concentration the equatorial E region varies as $\cos^{0.33} \chi$ (Krishnamurthy and Sengupta, 1972), where $\chi$ denotes the solar zenith angle, from which it is apparent that the diurnal variation profile of electron concentration does not change appreciably from one day to the other. However, the diurnal variation profile of the equatorial $\mathbf{H}$ field reveals substantial day to day changes which cannot be attributed to electron concentration alone. This suggests that the E region electric field varies differently on different days in order to account for the observed day to day changes in the daily variation profile of the equatorial $\mathbf{H}$ field. The time integrated area of the $\Delta \mathbf{H}$ curve, although gives the integrated product of the electric field and the electron concentration, it essentially represents the
integrated electric field only, on the basis of above arguments. The results presented in the following pages support our choice of the integrated electric field in the electrojet for comparing with the anomaly strength.

The work of Rastogi and Rajaram (1971), Rush and Richmond (1973) and Chandra and Rastogi (1974) shows that the difference of \( \Delta H \) field between an equatorial station (say Trivandrum, -0\(^\circ\)3 diplatitude) and a low latitude station just outside the effect of the electrojet (say Alibag, +12\(^\circ\).9 dip latitude) is a better measure of the electrojet current as compared to \( \Delta H \) field at Trivandrum only. The \( \Delta H \) field at Trivandrum represents the combined effect of theSq current, the electrojet current and the magnetospheric current. The magnetospheric contribution to \( \Delta H \) is negligible on magnetically quiet days. The \( \Delta H \) field at Alibag is caused by the Sq current and the magnetospheric current. As Alibag is not too far away from Trivandrum, the Sq contribution to the \( \Delta H \) field can be taken approximately the same at both the stations, on the basis of the latitudinal profile of the Sq given by Onwumechilli (1967). The magnetospheric contribution to \( \Delta H \) field is very nearly the same at both
the stations (Kane, 1973b). The subtraction of Alibag \( \Delta H \) from Trivandrum \( \Delta H \) removes the magnetospheric as well as the Sq contribution and thus \((\Delta H_T - \Delta H_A)\), where suffixes 'T' and 'A' denote Trivandrum and Alibag respectively, represents the contribution of only the electrojet current on quiet as well as disturbed days.

II. 3 DATA ANALYSIS AND RESULTS

We correlate the observed anomaly strength on a particular day with the electrojet strength represented in two ways: 1) the area under the \( \Delta H_T \) curve measured from the time when the \( H \) field rises above the nighttime base level up to the time of anomaly observation, and 2) the area under the \((\Delta H_T - \Delta H_A)\) curve measured in the same manner as for the \( \Delta H_T \) curve. In addition, we study the correlation between the anomaly strength and the midday ranges of \( \Delta H_T \) and \((\Delta H_T - \Delta H_A)\) curves, these two parameters being same as \( \Delta H_I \) and \( \Delta H_{II} \) respectively of Rush and Richmond (1973).

The parameter \( S (= R \times \phi) \) taken to represent the anomaly strength in the present study is the same parameter as used by Rush and Richmond. For the present study \( R \) is evaluated at 600 km altitude. The choice of 600 km altitude (rather than the \( h_{max} \) F2 altitude taken by Rush and Richmond) is made on the basis that the latitudinal profiles of electron concentration are available at this altitude for all the 116 passes of ISIS-1 and 2 satellites used in this study.
To obtain latitudinal distribution of electron concentration at $h_{\text{max}}^{\text{F2}}$ altitude it is necessary to have good quality ionograms, on which the echo traces are seen up to the penetration frequencies, throughout the entire duration of a satellite pass.

The parameters defined above for representing the anomaly and the electrojet strengths are illustrated in Fig. 2.2(a,b). Fig. 2.2(a) gives the constant height plot obtained from an ISIS-2 pass, showing ionisation anomaly at 1330 hr LT on April 20, 1972. The values of the electron concentration at the anomaly peak at 600 km altitude and that at the trough are $1.30 \times 10^6 \text{ cm}^{-3}$ and $6.60 \times 10^5 \text{ cm}^{-3}$ respectively. The crest to trough ratio $(R)$ of electron concentration is 1.97. The dip latitude of the anomaly peak at 600 km altitude is $14.0^\circ$ and the trough being at the magnetic equator, $\phi = 14.0^\circ$. The anomaly strength $S$ ($= R \times \phi$) is 27.6.

Fig. 2.2(b) gives the diurnal variation of $\Delta H_T$ and $(\Delta H_T - \Delta H_A)$ curves on April 20, 1972. The nighttime base levels, represented by $\Delta H_T = 0$ and $(\Delta H_T - \Delta H_A) = 0$, have been obtained by the method followed by Rush and Richmond. The two vertical arrows CD and IJ mark the time of anomaly observation on $\Delta H_T$ and $(\Delta H_T - \Delta H_A)$ curves respectively. The areas ABCDEA and GHIJKG under the $\Delta H_T$ and $(\Delta H_T - \Delta H_A)$ curves respectively, taken to represent the electrojet strength in the present.
Fig. 2.2(a,b): (a) Latitudinal distribution of electron concentration at various fixed altitudes on April 20, 1972 at 1330 hr LT and (b) diurnal variation of $\Delta H_T$ and $(\Delta H_T - \Delta H_A)$ on the same day.
study are denoted by $X_A$ and $Y_A$ respectively. The maximum ranges of the daily variation profiles of $\triangle H_T$ and $(\triangle H_T - \triangle H_A)$, given by the lengths of the arrows BE and HK, are denoted by $X_R$ and $Y_R$ respectively. It may be noted that the symbols 'X' and 'Y' represent $(\Delta H_T - \Delta H_A)$ respectively. The subscripts 'A' and 'R' denote "area upto the time of anomaly observation" and "maximum range" respectively of the daily variation profile of either 'X' or 'Y'.

Most of the ionisation anomaly data used in the present study is selected from the ISIS satellite passes recorded at Ahmedabad during the equinoctial months (March-April and September-October) of 1972-1974. During equinox period the two peaks of ionisation anomaly at any altitude are of equal strength and also equally distant (in latitude) from the magnetic equator, hence any one of the two peaks can be taken for evaluating the anomaly strength. During the solstice period, however, the summer peak of the anomaly at any altitude in the topside ionosphere is of higher strength than the corresponding winter peak. The satellite passes recorded at Ahmedabad usually cover only the northern peak of the anomaly. Thus the anomaly strength would be overestimated if evaluated from the northern peak during local summer and would be underestimated if the same peak is taken during local winter months.
Magnetically disturbed days \( A_p \geq 15 \) are omitted from the present study for the reason that the anomaly is shown to be either depleted or enhanced (Sato, 1968; Raghavarao and Sivaraman, 1973) because of storm induced changes in the electric field or in the neutral composition (namely the \( \frac{[O]}{[N_2]} \) ratio at the F region altitudes; Prolls and Von Zahn, 1974). The storm-time equatorward wind \( (\sim 50 \text{ m/s}) \) has also been suggested as a possible cause for the observed changes in the ionisation anomaly (Burge et al. 1973). The storm induced changes in the anomaly are therefore not due to the changes in the electrojet and hence it was considered desirable to confine the scope of the present correlative study of the two phenomena to quiet days only.

The anomaly data is grouped in hourly interval between 1000-1600 hr LT, the upper limit of the time interval as 1600 hr is due to the absence of sufficient number of anomaly data after this local time during the period under study.

The correlation coefficients between the anomaly and the electrojet parameters are calculated by the method of linear correlation (e.g. Young, 1962, p 126). The standard error \( \sigma \) in the correlation coefficient \( r \) is given as

\[
\sigma = (1 - r^2) \cdot (n - 1)^{1/2}
\]
where 'n' represents the number of pair of data points on which the correlation is based (Fisher and Yates, 1957; p 3).

Three representative plots of the correlation between the anomaly and the electrojet are shown in Fig. 2.3 (I - III). Each one of the plots is divided into parts (a), (b), (c), and (d) showing the correlation of the anomaly strength S with the four electrojet parameters \( X_A, Y_A, X_R \) and \( Y_R \) respectively. The straight lines drawn through the data points in parts (a) and (b) are regression lines obtained by the least square fitting.

Referring to Fig. 2.3 (I - III), at 1000 LT the correlation coefficients between the anomaly parameter S and the electrojet parameters \( X_A \) and \( Y_A \) are \((0.83 \pm 0.09)\) and \((0.89 \pm 0.06)\) respectively, whereas the correlation coefficients between S and the parameters \( X_R \) and \( Y_R \) are \((0.48 \pm 0.21)\) and \((0.52 \pm 0.20)\) respectively. At 1400 LT the correlation coefficients of the anomaly with the electrojet parameters \( X_A \) and \( Y_A \) are \((0.90 \pm 0.04)\) and \((0.94 \pm 0.03)\) respectively, whereas with the electrojet parameters \( X_R \) and \( Y_R \) the correlation coefficients are \((0.78 \pm 0.09)\) and \((0.82 \pm 0.07)\) respectively. At 1600 LT, the correlation coefficients between S and the electrojet parameters \( X_A, Y_A, X_R \) and \( Y_R \) \((0.83 \pm 0.08), (0.90 \pm 0.05), (0.65 \pm 0.15)\) and \((0.71 \pm 0.13)\) respectively.
Fig. 2.3(I, II): Scatter plots of correlation between the anomaly strength and the electrojet strength at 1000 hr and 1400 hr LT respectively. The two parameters correlated and the correlation coefficients obtained are mentioned in each of the compartments (a), (b), (c) and (d).
Fig. 2.5(III, IV): Same as in Fig. 2.5(I, II) at 1800 hr and 1000-1200 hr LT respectively.
However, it should be pointed out that small number of data points (average being about 16) for each individual hour makes the correlation less significant especially when it is low. For instance, corresponding to 16 pairs of independent data points the 95% significance level of the correlation coefficient, as given by Fisher and Yates (1957, Table VII), is about 0.47. This means that any value of 'r' greater than 0.47 can be taken as significant correlation. In order to ascertain whether the time integrated area of the electrojet strength is really a better parameter for comparing with the anomaly strength, we combine the data for three forenoon hours 1000, 1100 and 1200 LT. The total number of data points for these three hours is 49. From Fisher and Yates' table, the 95% significance level of the correlation coefficient for n = 50 is 0.27. Fig. 2.3 (IV) shows that the correlation coefficients of the anomaly strength \( S \) with the electrojet parameters \( X_A, Y_A, X_R \) and \( Y_R \) are \( (0.89 \pm 0.03), (0.94 \pm 0.02), (0.39 \pm 0.12) \) and \( (0.41 \pm 0.12) \) respectively. These values are above the statistically significant value of the correlation coefficient (0.27). The high correlation of the anomaly with the electrojet parameters \( X_A \) and \( Y_A \) and low correlation with parameters \( X_R \) and \( Y_R \) substantiates our suggestion that the time-integrated electrojet strength rather than its instantaneous midday strength should be compared with the observed anomaly strength at any local time.
Fig. 2.4 shows the diurnal variation of the correlation coefficient of \( S \) with \( X_A \), \( Y_A \), \( X_R \) and \( Y_R \) in the curves marked 'a', 'b', 'c' and 'd' respectively. The comparison of 'a' with 'b' shows that the integrated electrojet strength, \( X_A \), shows higher correlation, at any hour between 1000-1600 LT, than the maximum electrojet range, \( X_R \). Similarly the parameter \( Y_A \) shows higher correlation than \( Y_R \) with the anomaly strength \( S \), as apparent by comparing the curve 'c' with 'd'. It may be recalled that the parameters \( X_R \) and \( Y_R \) are the same as the parameters \( \Delta H_I \) and \( \Delta H_{II} \) of Rush and Richmond (1973). The daily variation of the correlation coefficient obtained by taking these parameters of the electrojet, shown by the curves 'b' and 'd', reveal low correlation especially in the forenoon hours similar to their results (reproduced in Fig. 2.1 for the parameter \( \Delta H_I \)).

It is also interesting to note from curves 'a' and 'c' of Fig. 2.4 that the correlation coefficient remains fairly constant (in the range 0.80 - 0.96) between the local times 1000-1600 hr, whereas the curves 'b' and 'd' reveal that the correlation varies appreciably (in the range 0.48 - 0.82) with time. This further shows that it is physically more meaningful to compare the time-integrated electrojet strength with the anomaly strength. Out of the two parameters \( X_A \) and \( Y_A \), the latter shows consistently
Fig. 2.4: Local time variation of the correlation coefficient between the anomaly strength S and the electrojet parameters $X_A$, $X_R$, $Y_A$, and $Y_R$. 

(1) S vs. 
(a) $X_A$ 
(b) $X_R$ 

(II) S vs. 
(c) $Y_A$ 
(d) $Y_R$
higher correlation with the anomaly strength than the former, as is apparent by comparing the curve 'a' with 'c'. This confirms the suggestion of earlier workers that the difference of the \( \Delta H \) field between the equatorial and a low latitude station just outside the electrojet belt should give a better estimate of the electrojet strength at any time than the \( \Delta H \) field at the equatorial station alone.

IIA CONCLUSIONS AND DISCUSSION

We have shown that the time integrated area of the \( \Delta H \) field at equatorial station (\( \Delta H_T \)) and the difference in the \( \Delta H \) field at an equatorial station and a non-equatorial station (\( \Delta H_T - \Delta H_A \)) correlate very well with the anomaly strength at any hour of the day. This can be understood in terms of the 'fountain theory' of the ionisation anomaly formation. The equatorial anomaly strength at any hour depends on the time integrated strength of the eastward electric field upto that hour rather than just the instantaneous midday value of the electric field.

Out of the two methods followed by the author for representing the electrojet strength, by the areas under the daily variation of \( \Delta H_T \) curve and the (\( \Delta H_T - \Delta H_A \)) curve, the latter shows higher correlation at any local time with the anomaly strength. This suggests that the electric field in the electrojet is more closely related to the parameter (\( \Delta H_T - \Delta H_A \)) rather than to \( \Delta H_T \). The electric field in
the E-region has been estimated by various authors (e.g. Dunford, 1967; Tarpley and Balsley, 1972; Krishnamurthy and Sengupta, 1972) using the $\Delta H$ field at the equatorial station only. However, our results confirm the suggestion of the earlier workers that the difference in the $\Delta H$ field at an equatorial station and that at a low latitude station is a better parameter for evaluating the electric field in the electrojet, and hence this quantity should be taken for evaluating the electric field in the electrojet region from the observed geomagnetic $H$ field variations.