Communications

Indian Journal of Radio & Space Physics
Vol. 11, December 1982, pp. 252-254

Dependence of Ionospheric Drift Speed on Geomagnetic Activity

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Received 28 *June* 1982; *revised received* 25 *October* 1982

Effect of geomagnetic activity on ionospheric drift speed is studied for Udaipur (geomag. lat., 14.55°N). To reduce the effect of solar activity, the study is made with the data obtained during Mar. 1974-Oct. 1975, a low activity period, and only those days for which 10.7 cm solar flux was below 90 have been considered. A negative correlation is found between noontime E-region apparent drift speed and geomagnetic K_p index. An identical relationship is obtained for nighttime apparent drift speed with K_p in case of F-region. The correlation coefficients deduced in the two cases are −0.81 and −0.86, respectively.

Among the various techniques used to study the ionospheric drifts, the simplest and most elegant method is Mitra's spaced receiver technique[1]. The work on drift measurements using this technique was initiated at Udaipur (geomag. lat., 14.55°N) in the later half of 1971. A high degree of correlation found between the results obtained during an intensive coordinated programme at Udaipur and Ahmedabad (geomag. lat., 14°N) has already established the validity of the technique[2]. Further, the drift patterns obtained over Ahmedabad and Yamagawa, the two tropical latitudes, have been found to be in good agreement with neutral wind model of G B Grobes[3]. The technical details of experimental set-up used in the present investigation are already discussed elsewhere[2]. The fading records so obtained are reduced by the time-delay method[1] of analysis.

Several workers at this latitude[4] (Udaipur) and other low latitude stations[5-7] have reported diurnal, seasonal and solar activity dependence of drift parameters. Therefore, the apparent drift speeds (V') obtained from time-delay method of analysis during Mar. 1974 and Oct. 1975 have been used taking following points into consideration.

(i) To further reduce the effect of solar activity, only those days for which 10.7 cm solar flux is less than 90 are considered.

(ii) Data corresponding to a fixed frequency of 2.5 MHz are used.

(iii) For noontime E-region study, only the drift speeds obtained at 1200, 1300 and 1400 hrs IST have been used for averaging.

(iv) The F-region drift speed does not show much variation throughout the night. Therefore, for nighttime F-region study the drift speeds obtained from 1800 to 0500 hrs IST have been taken and grouped on three hourly basis to accomplish averages corresponding to three hourly K_p values.

(v) The averages found above in (ii) for daytime E-region and in (iii) for nighttime F-region have been grouped independently for different values of K_p. The mean value of apparent drift speed corresponding to each K_p value is finally obtained.

(vi) Due to rare occurrence of E_s at this latitude and thin data available for daytime F-region reflections, the nighttime E-region and daytime F-region study could not be done.

The results are presented in Figs 1 and 2. A negative correlation is found between apparent drift speed and K_p index in case of both daytime E-region and nighttime F-region. The correlation coefficients as deduced from mean points are −0.81 and −0.86, respectively. All the data analysis made so far is contaminated with seasonal effects. The seasonal effect could not be removed for want of data. However, since the drift patterns recorded at Udaipur (geomag. lat., 14.55°N) and Ahmedabad (geomag. lat., 14°N) are identical, the apparent drift speed data obtained during Nov. 1973 and Feb. 1974 at the two stations have been mixed together to enlarge the data-base. This is done to carry out the study only for winter season. A negative correlation is found between the daytime E-region drift speed and K_p index. The correlation coefficient obtained in this case is −0.72 (not shown in the figures). The E W component of apparent drift velocity,

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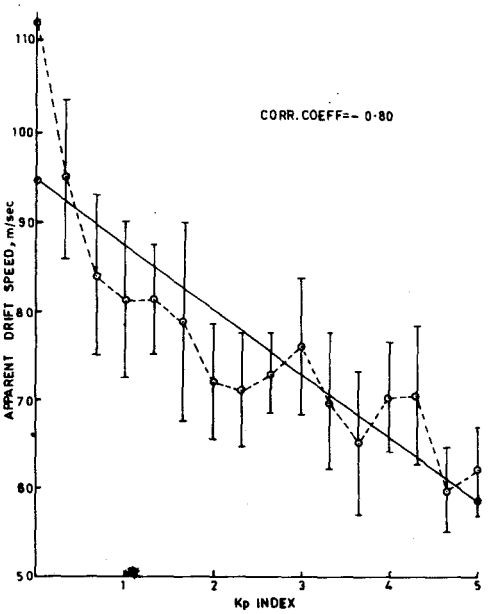

Fig. 1—Plots of noontime E-region apparent drift speed against K_p index (Solid line represents linear relationship computed by least square method and dashed curves are obtained by joining point to point.)

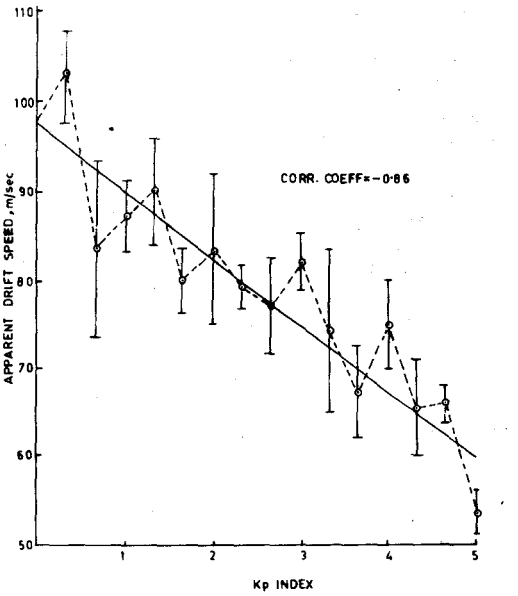

Fig. 2—Plots of nighttime F-region apparent drift speed versus geomagnetic activity index K_p

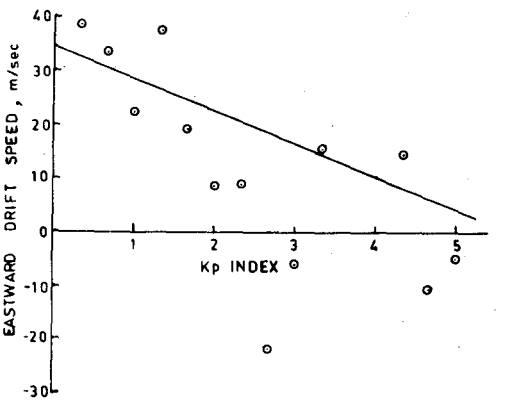

Fig. 3—Variation of eastward component of apparent drift velocity in the nighttime F-region with geomagnetic activity (The graph has been drawn by the method of least squares.)

which is normally eastward in nighttime F-region, is found to be reduced with the increase of geomagnetic activity (Fig. 3). During daytime the relationship between E W component of E-region drift velocity and K_p index is found scattered. Thus no definite conclusion could be drawn.

The effect of geomagnetic activity on ionospheric drift parameters has been studied by several workers at different stations. The general conclusion is that at high latitudes, E- and F2-region drift speeds increase with magnetic activity[8-11]. At Yamagawa (geogr. lat., 31° 13'N) the E-region drift speed is found to be increased on disturbed days[12]. However, the results reported from low latitude stations are contradictory. At Waltair, the E-region drift speed is found to increase with K_p index[13]. But at the same station the F-region drift speed is found to be increased in one study[14] whereas decreased under enhanced geomagnetic conditions in a different study[15]. Skinner *et al.*[16] and Rastogi *et al.*[17] have found negative correlation between E- and F-region drift speed and K_p index at Ibadan and Thumba (dip 0.6°S), respectively. The negative correlation between the said two parameters for E- and F-region obtained in the present case is in agreement with the results reported from Thumba and Ibadan. The present results also agree partially with those obtained at Waltair.

One of the authors (DVS) is grateful to the University Grants Commission, New Delhi, for granting him a teacher research fellowship while doing the present work. The authors also gratefully acknowledge the fruitful discussions offered by Prof. R G Rastogi and the assistance given by Dr A V Janve in preparing this communication.

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