Latitude Variation of the Effect of Magnetic Activity on Ionospheric Drifts

THE effect of magnetic activity on horizontal drifts in the ionosphere has been reported by several investigators[1]. This communication deals with the effect of magnetic activity on ionospheric drifts at various latitudes with the objective of making apparent the variation in drift speeds with latitude under active magnetic conditions. We have used data on horizontal drifts available from World Data Centers for the IGY period and the drift stations are selected so as to represent a particular range of latitude. The drift speeds and the corresponding K index values are tabulated for all the drift recording stations and corresponding nearest magnetic observatories (Table 1). The tabulated values are then averaged and the average drift speed values for each corresponding K index are plotted as shown in Fig. 1.

The drift speed in the E region increases with magnetic activity at all stations, more rapidly at higher values of K index. In both hemispheres the effect of magnetic activity on drift speed is greater at higher latitudes.

There is an interesting variation in the values of $F2$ region drift speeds with latitude during magnetic activity. At Waltair the drift speed is found to decrease with increasing K index, so that the drift speed and K index are inversely correlated at the low latitudes. At Yamagawa and Askhabad the K index has practically no effect on drift speed. At Simeiz the effect of magnetic activity on drift speed is positive, and at Gorky the drift speed is found to increase linearly with K index up to $K=3$, after which the increase is more rapid with increasing K index. The effect of magnetic activity on drift speed is quite prominent at high latitudes. In summary, the negative correlation of drift speed with K index at low latitudes changes gradually to a positive correlation at high latitudes, the reversal taking place about 30° geomagnetic latitude.

The morphology of the F region during storms has been extensively studied[2]. At high latitudes there is a marked decrease in peak electron density with a pronounced diurnal variation, but at low latitudes there is often an increase of electron density. The variation at intermediate latitudes showed a marked diurnal control and an overall depression, except for an occasional increase during the winter. Bowles[3], from incoherent scatter radio soundings at Jicamarca, reported an increase in electron density at equatorial latitudes during geomagnetic storms.

Kohl and King[4] have shown that neutral air pressure gradients at F region heights produce important atmospheric winds, the force of which is influenced by viscous, Coriolis and ion drag forces. They also estimated that atmospheric winds of the order of 100 m s^{-1} exist at most latitudes when $NmF2$ is 3×10^5 cm^{-3} and of the order of 35 m s^{-1} when $NmF2$ is 10^6 cm^{-3}; this inverse relationship is a consequence of ion drag forces. An increase in electron density concentration increases the collision frequency between ions and neutrals, and this results in more ion drag force and hence decreases the magnitude of the wind speed. Kohl and King also suggested that ionospheric drifts produced by the atmospheric winds may help to explain many of the F region anomalies. In the present investigation, a decrease in drift speed is observed with a corresponding increase in electron density concentration at low latitudes in magnetically active conditions. An

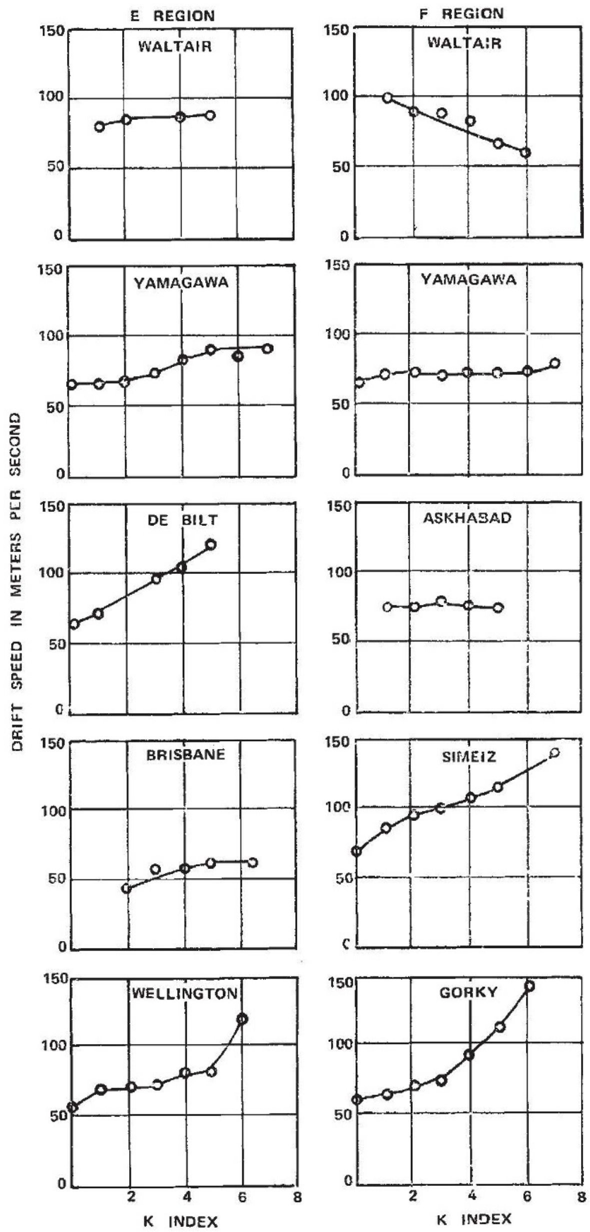

Fig. 1.

increase in electron density leads to more ion drag forc opposing the movements and thus the drift speed shows negative correlation with electron density. Alternatively at high latitudes, in active magnetic conditions, a decreas in electron density is observed. This indicates that the io drag force opposing the movements is low at high latitude and consequently the drift speed increases and is positivel correlated with K index. This investigation on F regio drifts in active magnetic conditions attempts to show th latitude variation and points out an interesting correlatio between drift speeds, electron densities, global win system and K index.

Table 1. LOCATIONS OF DRIFT STATIONS WITH THE NEAREST MAGNETIC OBSERVATORIES USED IN THE INVESTIGATION

Drift station	Geomagnetic latitude	Magnetic observatory	Geomagnetic latitude
Waltair	7·5° N	Alibag	9·5° N
Yamagawa	20·3° N	Kanoya	20·7° N
Askhabad	30·6° N	Askhabad	30·6° N
Simeiz	40·5° N	Sucari	42·5° N
Gorky	50·0° N	Chambon-La-Foret	50·4° N
DeBilt	58·8° N	Witteveen	54·2° N
Brisbane	35·8° S	Brisbane	35·8° S
Wellington	51·7° S	Amberley	47·7° S

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