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On the Growth & Decay of Blanketing Sporadic-E Layers

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Evidence is presented from 1-min interval ionogram data to show that strong blanketing-layer-type ionization irregularities at E-region altitudes can occasionally decay, in a span of about 4 min, at stations in the vicinity of the geomagnetic dip equator.

Substantial evidence exists in the literature to show that thin layers of enhanced ionization at E-region altitudes which manifest as extended E-region traces on ionograms known as "blanketing sporadic-E" layers,[1-3] do occur at and close to the magnetic dip equator.[4-8] As the effectiveness of the vertical ion convergence mechanism, which is widely considered[9-11] responsible for the formation of blanketing sporadic-E layers at temperate latitudes, reduces sharply close to the dip equator,[11] alternative mechanisms have been proposed to account for the occurrence of blanketing sporadic-E layers at and close to the dip equator. One of them is ion convergence by horizontal shears of horizontal neutral winds induced by short period internal

gravity waves[6] and another is physical transport of ionization of long-lived metallic ions from tropical latitudes towards the dip equator by neutral winds.[7] The morphological behaviour of blanketing sporadic-E layers at and in the vicinity of the dip equator has been well documented in the recent times. It is now known that (i) blanketing sporadic-E layers occur most frequently during local summer months of low sunspot activity periods and with a characteristic diurnal variation with a prominent peak around 1700 hrs LT and (ii) they occur mostly in a narrow height range 95-105 km and under conditions of weak equatorial electrojet.[4,6-8] Although the usually available quarter-hourly ionogram data do indicate the growth and decay of blanketing sporadic-E layers at and close to the dip equator to be rather rapid[8] (< 15 min), there is a dearth of observations on this aspect of blanketing sporadic-E layers with a time resolution better than 15 min. With a view to fill in this gap, a preliminary study is attempted and the results are presented in this communication.

Vertical incidence ionospheric soundings with a C-3 ionosonde have been carried out at Kodaikanal (dip 3 5°N) at 1-min intervals on a number of days during the period Oct. 1974 - Jan. 1975, with a view to monitor the small-scale fluctuations in the F-region critical frequency. These ionogram sequences with a high-time resolution have been used in the present study. Careful scrutiny of the available ionogram data showed the occurrence of blanketing sporadic-E layers during daytime conditions on five occasions. The blanketing frequency (f_b Es) which represents the peak electron density of the sporadic-E (Es) layer, is scaled at 1-min interval on these five occasions to infer the growth and decay times of the Es-layers.

It is found that on four occasions, the blanketing Es-layers showed a smooth development and decay with growth times ranging from 6 to 12 min and decay times from 8 to 19 min. The layers on these occasions were of moderate to strong blanketing type with intensity factors (ratio of peak electron density in the Es-layer to that of the ambient) ranging from about 1 5 to 4. The blanketing Es-layer on the fifth occasion, however, showed a different and interesting behaviour. This event occurred during the time interval 1030-1120 hrs IST on 17 Nov. 1974. Fig.1 shows the time evolution of f_b Es for this day. The development of the blanketing Es-layer seems to have occurred in two stages on this day as can be seen from Fig.1.

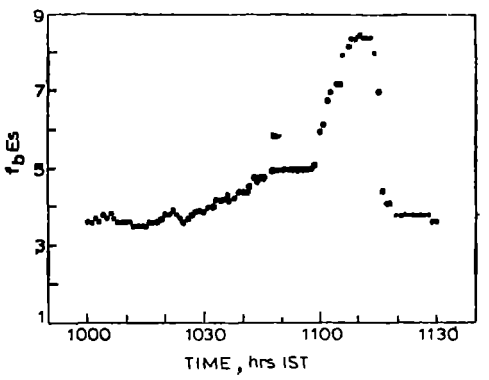

Fig. 1—Variation of f_b Es at Kodaikanal on 17 Nov. 1974 during the time interval 1000-1130 hrs IST

The value of f_bEs started to increase from 4 0 MHz at 1030 hrs IST and reached 5 0 MHz at 1047hrs IST where it remained constant for 12 min It then rose sharply to reach a maximum value of 8·4 MHz at 1108 hrs IST The critical frequency of the E-layer (f_0E) will usually be about 4·0 MHz around this time of a day. The f_bEs value of 8·4 MHz indicates a strong blanketing Es-layer with an intensity factor of 4 or more on this occasion. It may be noted that blanketing Es-layers during daytime typically exhibit intensity factors in the range 1·5-2·5 (Ref.6). The decay of this strong blanketing Es-layer, in contrast to its growth, was remarkably rapid as can be clearly seen from Fig.1. The value of f_bEs dropped from 8·4 MHz at 1113 hrs IST to 4·1 MHz at 1117 hrs IST, i.e. the peak electron density of the Es-layer returned to more or less its usual value within a span of 4 min. The other interesting features of the blanketing Es-layer on this occasion are (i) its occurrence around mid-day—a rarity and (ii) its occurrence at a height of 120 km well above the usually observed narrow range of 95-105 km.

Further 1-min interval ionospheric soundings are in progress at this station to obtain a comprehensive picture of the growth and decay characteristics of blanketing sporadic-E layers.

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