Communications

TEC Enhancement during Periods of Major Meteor Showers

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The enhancement in TEC during the periods of some major meteor showers is estimated utilizing the 136 MHz ETS-II Faraday rotation measurements carried out at Hyderabad (17.5°N, 78.3°E), a low latitude station. The Geminid meteor shower produced maximum enhancement (about 40 per cent) compared to other showers. These observations show that there is a definite contribution to TEC of the ionosphere due to the ionization produced by the meteors during the shower periods.

The increase in E region ionization is correlated to $E_s$ by various observers. The occurrence of $E_s$ is found to be more during the periods of major meteor showers like Geminid, Leonid, etc. Recent rocket-borne studies over Thumba firmly established that the sporadic E layers are formed by meteor showers only.

In the light of these findings an attempt has been made to estimate the TEC enhancements during shower periods by analysing TEC measurements made at Hyderabad.

The TEC represents the integrated value of electron content in a vertical column of unit cross-section extending from ground to the height of the satellite. In geostationary satellites like that of Japanese ETS-II, the TEC represents only up to the height of about 1800 km (Ref. 4). The main regions of the ionosphere which contribute to the TEC value are E and F regions with a predominance of F region. It has been found by Lebedinets and Shushkova that micro-meteoric influx can lead to substantial ionization due to sputtering effects at heights ranging between 130 and 140 km. These meteoric ionization effects are found to be more during intense shower periods and during latter half of the night than during the daytime. Hence it has been thought that some of the meteor showers may produce substantial increase in ionization during the shower days, which may give rise to more enhancement in TEC values, than on other days.

The percentage increase in TEC during some major meteor shower periods has been calculated and presented in this communication.

The phase rotations of 136 MHz radio signals transmitted by the Japanese geostationary satellite ETS-II were recorded using a satellite radio receiving system. The receiver was a two-channel double frequency conversion phase-lock system. It contained an automatic lock acquisition for both channels with lock-in indication by LEDs and displayed search range and universal outputs for both amplitude and phase chart recorders. The receiving antenna was a 12-element crossed yagi system. The receiving system was operated round the clock since 1979. From the phase recordings, the TEC values of 15-min interval were derived by adopting Farady rotation method. The TEC thus obtained was averaged for obtaining diurnal variations which were used in the study of TEC enhancement during shower periods. The enhancement during shower periods in solar maximum period (1979-80) was compared with that observed during solar minimum period (1975-76). Since the observational data during solar minimum period at Hyderabad were not available, the data recorded at other low latitude stations, namely, Waltair and Ahmedabad, have been utilized in the present investigation.

The TEC variations during Geminid meteor shower period are presented in Fig. 1. Curve (a) represents the TEC variation during shower days (11-14 Dec.), and curves (b₁) and (b₂) during pre- and post-shower periods respectively for the solar minimum period. Similarly, curve (c) represents the TEC variation during shower days as in the case of curve (a), and curves (d₁) and (d₂) during pre- and post-shower periods respectively for the solar maximum year 1979. It is seen from Fig. 1 that there is a considerable enhancement in TEC during Geminid meteor shower period in the

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high solar activity period compared to that in the low solar activity period. The percentage of increase in TEC is found to be 40 at the time of occurrence of peak of the shower. No magnetic storms were found to be recorded during this period and the magnetic index $A_p$ on these days was less than 4. However, the examination of the ionograms obtained during this period at the Physical Research Laboratory, Ahmedabad, showed frequent occurrence of 'blob' type $E_s$ due to intense meteoric influx during the active period of Geminid meteor shower than during the pre- and post-shower periods. This is a clear indication of the increase in ionization due to Geminid meteor shower at low latitudes.

The TEC enhancement during the Leonid meteor shower period is presented in Fig. 2. Curves (a), (b1) and (b2) represent the TEC variations in the solar minimum year 1975 during shower days (15-18 Nov.), and pre- and post-shower days respectively. Similarly, curves (c), (d1) and (d2) represent the TEC variations in the solar maximum year 1979. The Leonid shower also produced considerable enhancement in TEC, about 20 per cent, during solar maximum year. Such enhancement was not found during the solar minimum year 1975. The TEC enhancement during the Leonid meteor shower period is only about 50 per cent of that of the Geminid shower period. The ionograms also showed less number of occurrences of meteoric $E_s$ during the Leonid meteor shower period compared to that of the Geminid shower.

The variations in TEC during Orionid meteor shower period 20-23 Oct. for the solar minimum and
From the study of the variations of TEC measured at Hyderabad during the periods of major meteor showers like Geminid, Leonid, Orionid and Perseid, it is found that there is a considerable enhancement in TEC values during the meteor shower periods in the solar maximum period compared to that of quite sun period. The Geminid shower, which is an intense and more prominent one, produced maximum enhancement (about 40 per cent) compared to the other showers. The ionograms also showed the maximum number of occurrences of meteoric Es (blob type) during this shower period compared to other showers. These observations show that there is a definite contribution to TEC of the ionosphere due to the ionization produced by the meteors and micro-meteors during the shower periods.

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References