Sporadic-E associated with the Leonid meteor shower event of November 1998 over low and equatorial latitudes

H. Chandra¹, S. Sharma¹, C. V. Devasia², K. S. V. Subbarao², R. Sridharan², J. H. Sastri³, and J. V. S. V. Rao³

¹Physical Research Laboratory, Ahmedabad, India 380 009
²Space Physics Laboratory, VSSC, Trivandrum, India 695 022
³Indian Institute of Astrophysics, Bangalore, India 560 034

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Abstract. Rapid radio soundings were made over Ahmedabad, a low latitude station during the period 16–20 November 1998 to study the sporadic-E layer associated with the Leonid shower activity using the KEL Aerospace digital ionosonde. Hourly ionograms for the period 11 November to 24 November were also examined during the years from 1994 to 1998. A distinct increase in sporadic-E layer occurrence is noticed on 17, 18 and 19 November from 1996 to 1998. The diurnal variations of \( f_0E_s \) and \( f_bE_s \) also show significantly enhanced values for the morning hours of 18 and 19 November 1998. The ionograms clearly show strong sporadic-E reflections at times of peak shower activity with multiple traces in the altitude range of 100–140 km in few ionograms. Sporadic-E layers with multiple structures in altitude are also seen in some of the ionograms (quarter hourly) at Thumba, situated near the magnetic equator. Few of ionograms recorded at Kodaikanal, another equatorial station, also show sporadic-E reflections in spite of the transmitter power being significantly lower. These new results highlighting the effect of intense meteor showers in the equatorial and low latitude E-region are presented.

Key words. Ionosphere (equatorial ionosphere) – Radio science (ionospheric physics)

1 Introduction

The Leonid meteor shower is known to have strong activity every 33 years, which is the period of the Tempel-Tuttle, the parent comet of the shower. During the last return in 1966, visible meteors with an hourly rate of 140,000–150,000 were reported in the West Coast of America (Milon, 1967). A meteor outburst of Leonids was observed in November 1994 and strong meteor shower was predicted to occur in 1998 or 1999 (Jenniskens, 1996). Though a strong outburst was not expected in 1997, optical meteor observations were made in 1997 by Kinoshita et al. (1999) because the distance between the descending node and the parent comet was much smaller in 1997 than in 1998. A strong event of meteor burst with 100–150 meteors in 2 seconds was observed at the time of the descending node of the comet at 1331 h UT on 17 November 1998. The observed rate was comparable to the maximum hourly rate reported in 1966.

There were several observations planned for the Leonid shower event of November 1998. One of the effects of the meteor showers is the enhanced activity in the formation of sporadic-E layers in ionosphere. Rapid radio soundings were made over Ahmedabad (23.0° N, 72.4° E, dip 34° N) to study the effects of the meteor shower on the ionosphere. Ionograms were recorded at an interval of five minutes during the hours from midnight to morning of 17–19 November and every minute from 03–06h of 18 November 1998. Ionograms at Thumba (8.3° N, 76.9° E, dip 0.6° N) and Kodaikanal (10.2° N, 77.5° E, dip 6° N), located near the magnetic equator were also examined. The sporadic-E layers associated with the Leonid meteor shower event of November 1998 are reported in the present communication.

2 Results

The daily mean percentage occurrence of sporadic-E over Ahmedabad is compared for the days from 11 to 24 November of the years 1994 to 1998 from the hourly ionograms and shown in Fig. 1. The percentage occurrences are rather low during the years 1994 and 1995 with values ranging between 15 and 50% on different days. However there is an increase seen from the year 1996 with daily mean percentage occurrences reaching as high as 80% on some days. Considering the days 17 to 19 November only, the percentage occurrences are 15, 40 and 40 in 1994; 15, 20 and 50 in 1995; 40, 50, and 35 in 1996; 50, 60 and 20 in 1997 and 75, 80 and 40 in 1998. Thus it appears that there is an increase in the occurrence of sporadic-E in the years 1996 through 1998. We have also examined the occurrence of nighttime sporadic-E (20–06h) and the results are shown in Fig. 2. The occurrence of sporadic-E...