Survey of Meteor Signal Rates Observed over a VHF Forward-scatter Link between Waltair & Dehra Dun

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Diurnal and day-to-day variation in meteor signal rates observed for a period of one year over a VHF forward-scatter link between Waltair and Dehra Dun (a distance of 1533 km) at 48.2 MHz are presented. The diurnal variations of meteor rates are discussed and the results are compared with the meteor wind radar observations at Waltair.

1 Introduction

It is well understood that the ionization produced by the passage of a meteor into earth's atmosphere serves as a radio target and it thus makes a new method possible for studying both the astronomical properties of meteors and the physical conditions in the atmosphere. The scattering of radio waves by meteor trails has been studied extensively in the past, originally for the back-scatter case, by McKinley and Millman, Lovell and Manning. Later, it has been extended to forward-scatter techniques using continuous wave transmission with relatively small radiated power. An extensive study of radio meteors using forward-scatter system has been carried out by a number of workers. In this paper, the results of the analysis of continuous recording of meteor echoes observed on a forward-scatter link experiment conducted between Waltair and Dehra Dun during the period Dec. 1974-Nov. 1975 are presented.

2 Experimental Set-up

The CW transmissions at 48.2 MHz and 200 W power from Dehra Dun are received at Waltair at a distance of 1533 km by way of meteor forward-scatter. Six-element Yagi antennas with 10 dB gain are used both at the transmitting and receiving ends and directed towards the meteoric region at a height of 100 km above the ground midway between the two stations. The meteor echoes are recorded continuously at Waltair using a Brush recorder during the second half of every hour and round the clock. The complete details of the experimental set-up have been published elsewhere. The method of analysis of the forward-scatter meteor records has already been published in an earlier paper by Rao et al.6

3 Diurnal Variation of Meteor Rates

The meteor signal rates for the corresponding hour in each month have been averaged and the average diurnal variation in the hourly meteor rates for all the 12 individual months are shown in Fig.1. Error bars

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Fig. 1 - Monthly mean diurnal variation of meteor signal rates from January to December
were calculated from the total number of meteor echoes contributing to each data point and represented in Fig.1. The most common feature observed in all these curves is that they exhibit a maximum activity around 0600 hrs LMT and a minimum around 1800 hrs LMT. The early morning peak and evening dip in meteor activity are due to well known "Apex effect" (Ref.8) assuming an isotropic distribution of sporadic meteor radiants. Similar results have also been obtained by many others9,10. However, following the latitudinal dependence of meteor rates reported by Whipple11 and Lovell2, the observed crest at early morning hours and trough at evening hours coincide with the expected diurnal variation of meteor activity for Waltair, a low latitude station. Besides the above characteristic features in diurnal variation curves, a sharp fall in meteor activity at around 0800 hrs LMT is also noticed in most of the cases. This less meteor activity may be due to the rapid increase in absorption at D-region height12. The unsteady conditions in the ionosphere around this time (0800-1000 hrs), resulting in rapid layer movements may also be a cause for the decreased activity. The same facts have also been noticed in the diurnal variation curves established by meteor wind radar measurements at Waltair13,14. The diurnal variation gets also markedly affected by any meteor shower8. During the months September to December the 0600 hrs peak is shifted towards earlier hours probably due to non-isotropic distribution of sporadic meteor radiants. During the same months another peak is also observed which coincides with the time of upper transit of the major meteor showers like Orionids, Leonids and Geminids indicating a large influence of these meteor showers on the diurnal activity.

4 Day-to-day Variation of Daily Mean Hourly Meteor Rates

The daily mean hourly meteor rates for the period Dec. 1974 - Nov. 1975 are obtained by averaging all the hourly values in each day. This day-to-day variation of daily mean hourly meteor rates of the whole day for the above period is shown in Fig.2. The curve showing the day-to-day variation of meteors activity suffers great increases at irregular intervals due to the occurrence of major and minor meteor showers. In particular, the increased activity is prominently seen during the active periods of meteor showers presented in Table 1. Although these meteor showers are highly active, owing to their short lived activity their contribution to the total number of meteors entering the earth's atmosphere during the year is considerably less than the contribution from the sporadic meteors.

### Table 1 - Major Meteor Showers with Date of Peak Activity

<table>
<thead>
<tr>
<th>Name of the shower</th>
<th>Date of peak activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geminids</td>
<td>12 Dec. 1974</td>
</tr>
<tr>
<td>Quadrantids</td>
<td>3 Jan. 1975</td>
</tr>
<tr>
<td>Lyrids</td>
<td>20 Apr. 1975</td>
</tr>
<tr>
<td>Eta Aquarids</td>
<td>4 May 1975</td>
</tr>
<tr>
<td>Arietids</td>
<td>4 June 1975</td>
</tr>
<tr>
<td>Zeta Perseids</td>
<td>7 June 1975</td>
</tr>
<tr>
<td>Beta Taurids</td>
<td>29 July 1975</td>
</tr>
<tr>
<td>Capricornids</td>
<td>25 July 1975</td>
</tr>
<tr>
<td>Iota Aquarids</td>
<td>3 Aug. 1975</td>
</tr>
<tr>
<td>Perseids</td>
<td>14 Aug. 1975</td>
</tr>
<tr>
<td>Kappa Cygnids</td>
<td>20 Aug. 1975</td>
</tr>
<tr>
<td>Orionids</td>
<td>20 Oct. 1975</td>
</tr>
<tr>
<td>Taurids</td>
<td>2 Nov. 1975</td>
</tr>
<tr>
<td>Leonids</td>
<td>17 Nov. 1975</td>
</tr>
</tbody>
</table>

Fig. 2 Day-to-day values of mean hourly meteor signal rates of whole day for the period Dec. 1974-Nov. 1975
On the basis of meteor activity, Leonid is by far the strongest shower followed by Geminid and Quadrantid showers. The daytime showers are Arietids, Zeta Perseids, Beta Taurids and Capricornids. Normally meteor showers last from several days to several weeks, depending on the individual shower. Meteor shower activity is superimposed over the sporadic background. So the rate increase, depending on the shower activity, may not always be particularly marked. The meteor rate for individual shower and the date of peak activity during a shower can vary from year to year. Fourteen well marked shower peaks and their dates of peak activity are presented in Table 1. They are consistent with those already presented by McKinley.

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