Study of High/Low Amplitude Wave Trains in CR Intensity and Associated Solar Features

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Abstract

Cosmic Ray intensity data for a period of over a decade (i.e., 1989–1990) from various neutron-monitoring stations; situated at different latitudes, have been investigated for the high/low amplitude anisotropic wave train events (HAE/LAE). It has been found that the diurnal phase of cosmic ray anisotropy appears to be independent of amplitude, as no synchronization in variations is seen between them for majority of the HAE/LAE cases. However, the phase of the semi-diurnal anisotropy for HAE has been found to shift towards later hours for all the events. The geomagnetic activity index Ap has been observed to remain low during the period of each HAE/LAE. The possible phenomenon to cause such high/low amplitude anisotropic wave trains has been proposed to appear on the back of the visible side of the Sun.

1. Introduction

A systematic and significant variability in Cosmic Ray (CR) intensity is known to occur with strong geomagnetic activity (Mavromichalaki, 1980; Fluckiger, 1991)[3,1]. The diurnal anisotropy has close association with geomagnetic conditions; and further, the Ap indices are reported to be correlated with both diffusive and convective components of the simple convection diffusion theory. This investigation attempts to study the effects of interplanetary transients causing unusual behaviour in CR intensity during the period 1980–90.

2. Data Analysis

The anisotropic wave train events are identified from the hourly plots of the CR intensity recorded at Deep River and Tokyo Neutron Monitoring (NM) Stations. The days having abnormally High/Low diurnal amplitudes for successive number of five or more days have been selected as HAE/LAE. The average normal amplitude of the diurnal anisotropy (0.4%) is taken as a reference line.

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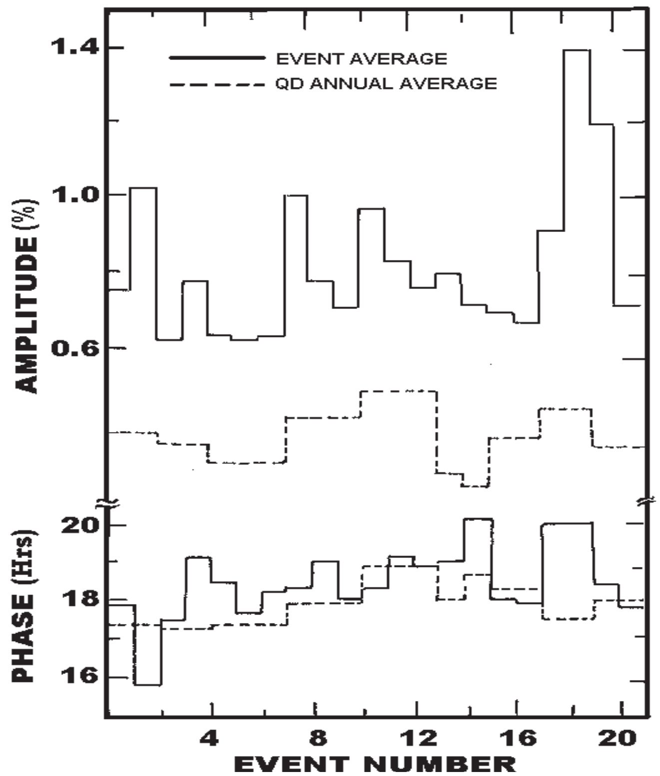

Fig. 1. Amplitude and Phase of the Diurnal Anisotropy for each HAE along with the corresponding QD annual average values; during the period 1981–1990.

3. Results, Discussion and Conclusions

It is quite apparent from the Fig. 1 that the amplitude of the diurnal anisotropy for every individual HAE case is significantly larger than the Quiet Days (QD) annual average amplitude throughout the period of investigation i.e., 1981–90 and the phase of the diurnal anisotropy has shifted to later hours for majority of the events as compared to the annual average values confirming earlier results (Kumar et al, 1997)[2]. Further, the amplitude and phase of the diurnal anisotropy for each case of HAE during 1981–90 are also plotted as a vector addition diagram for Deep River and Tokyo neutron monitoring stations in Fig. 2. It is quite observable that the trend in the variation of the diurnal anisotropy at two widely located neutron monitoring stations with different cut-off rigidities is almost comparable. It has also been observed that the amplitude of the semi diurnal anisotropy for each HAE remains statistically constant, as depicted in Fig. 3. However, the phase of the semi diurnal anisotropy has been found to shift to later hours for all HAEs. The time of maximum for semi diurnal anisotropy is consistent with the earlier findings (Venkatesan and Mathews, 1968)[4].

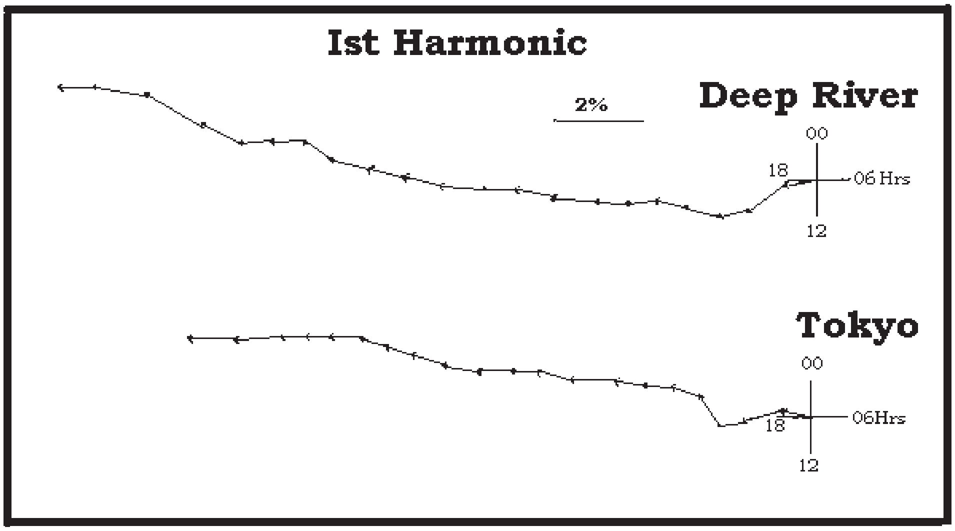

Fig. 2. Vector addition diagrams of the first harmonic for Deep River and Tokyo NM Stations.

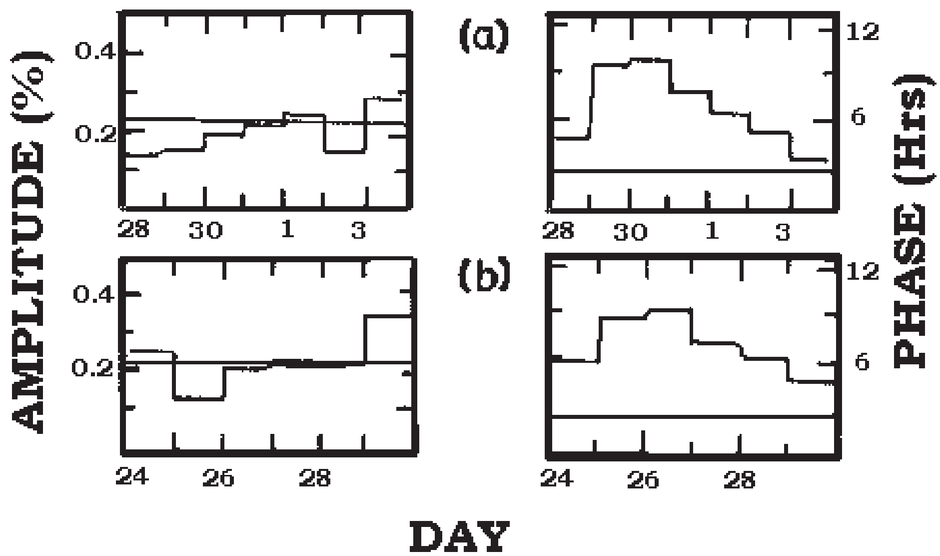

Fig. 3. Amplitude and phase of the semi-diurnal anisotropy for (a) 28 Jan.–3 Feb.1988 and (b) 24–29 Sep. 1983.

Fig. 4 depicts the average values of the amplitude (%), phase (Hrs) the plotted with geomagnetic activity index-Ap. It does not indicate any significant trend among these parameters. However, Ap-index on an average basis remains low during the period of each HAE/LAE cases, investigated here. It may be

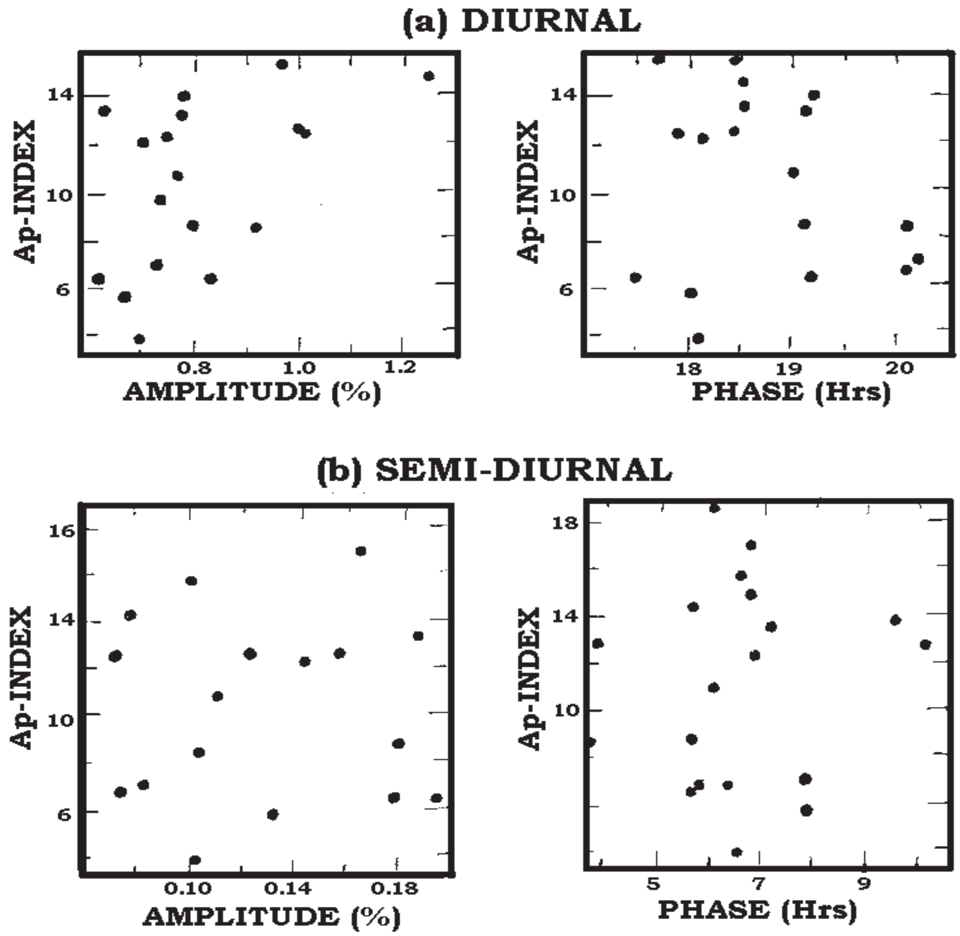

Fig. 4. Amplitude and phase of the (a) Diurnal and (b) Semi-diurnal anisotropy for each HAE alongwith Ap-Index.

because of the solar activity on the back side of the visible solar disk and the interplanetary disturbances responsible for such effects in CR modulation have not reached earth.

4. References

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3. Mavromichalaki H. 1980, Astrophys. and Space Sci., 68, 137–149.
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