29th International Cosmic Ray Conference Pune (2005) **00**, 101-103

Study of the characteristics of low and high amplitude diurnal wave trains of cosmic rays

Ajay K. Pandey, G. K. Pandey, C. M. Tiwari
Dept. of physics,APS University, Rewa (M .P.) India
Presenter: Mr. G.K. Pandey (tiwaricm123@rediffmail.com), ind-tiwari-CM-abs1-sh34-poster

The average characteristics of the daily variation of cosmic rays have been continuously reported since the period of IGY. The changes on a day- to -day basis is quite large, even for the first harmonic of the daily variation, whose observed amplitude, at a high/middle latitude neutron monitor station is ≈ 0.3 %. Such a variability is induced due to continuously variable interplanetary conditions, mainly on short- time scales. A critical examination of the daily values of neutron monitors reveals that there exist stable periods of few days, where the diurnal amplitude is either sufficiently high or low continuously as compared to the annual mean values. Such continuous days with diurnal amplitudes ≥ 0.5% for high amplitude events, for 5 or more days, and with diurnal amplitudes ≤ 0.25% for low amplitude events, have been selected for the period 1989 to 2004. The average diurnal and semi-diurnal anisotropy has been derived for all such individual events as well as for each year. It is found that the high amplitude events are generally associated with the days of low to moderate geomagnetic activity, whereas the low amplitude events are associated with moderate to high geomagnetic activity.

1. Introduction

The days with high diurnal amplitudes occurring continuously for many days, with or without the shift in the time of maximum from the normal to later or earlier hours are can be categorized separately as high amplitude events. The existence of such a high diurnal amplitude wave trains as well as low amplitude events have been reported earlier [1]. The explanation of the existence of such large diurnal amplitude days, using the well-known equilibrium conditions of the corotation theory, has not been very satisfactory. Enhanced diurnal amplitudes due to an excess flux coming from the ~ 21 hour direction [2] is often observed during the recovery phase of a Forbush decrease. Recently, many workers such as Kumar et al [3], Kumar and Chauhan [4], Chauhan et al [5], Pandey [6] have analyzed the high amplitude anisotropic wave train events and its relation with solar and interplanetary parameters.

2. Discussion

Based on the strict selection criteria of the diurnal amplitude ≤ 0.25 %, at a high / middle latitude station, for low amplitude events, and the diurnal amplitude ≥ 0.5 % for high amplitude events, for 5 or more days, we have selected days using the daily harmonics data of Kiel neutron monitor station. 64 low diurnal amplitude events and 29 high diurnal amplitude events have been detected during the interval 1989 to 2004. For comparison, we have checked the data of a number of other high and low latitude neutron monitors, and they also show consistent results. The days of high and low diurnal amplitudes occur continuously as trains of days almost with equal probability during the entire solar cycle. The tendency of higher rate of occurrence of low amplitude wave trains is found to be during low sunspot activity period, whereas the rate of occurrence of the high amplitude wave trains is significantly low during low sunspot activity period. The high amplitude wave train events are generally associated with days of low to medium geomagnetic disturbances, whereas the low diurnal amplitude wave train events are generally associated with moderate to high geomagnetic disturbance days. To derive the characteristics features of these high amplitude events, we have calculated the differences between the Kiel (high latitude) Haleakala(low latitude) neutron monitor station. The ratio of Kiel to Haleakala amplitude is found to be in general about 1.5, which is slightly more than that obtained for their annual average values. The average diurnal amplitudes for the low amplitude events are so small that no worthwhile results, from such a comparison of the ratio, can be obtained. We have also compared the annual average values of the diurnal phases for both types of events (LAEs and HAEs). The observed values of the diurnal phase are given in Table-1 and Fig. 1.

Table 1 Average Diurnal Phase

Year	HAE Phase	Yearly. Phase	LAE Phase
1989	0	218	0
1990	0	203	0
1991	213	210	244
1992	158	182	187
1993	192	190	231
1994	175	187	210
1995	0	175	138
1996	0	163	182
1997	0	158	149
1998	89	185	178
1999	196	192	219
2000	216	203	206
2001	210	214	207
2002	218	212	0
2003	193	218	256
2004	216	218	214

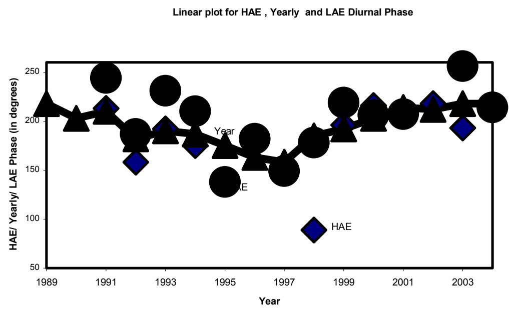

Figure 1. Shows the plot for the annual average diurnal phase for two types of events (High diurnal amplitudes-HAE and low diurnal amplitudes-LAE) observed at Kiel station for the years 1989 to 2004. The annual averages are shown by triangle and joined by thick lines. The points for HAE/ LAE missing in certain years are because no events have been detected.

The gap in the table means that there are no events in that year. In general, we notice that the diurnal phase is in later hours for LAEs and slightly earlier hours in case of HAEs, as compared to the annual averages for all days (less UT affected days). Nevertheless, such changes are more significantly apparent when we consider individual events.

When we consider the effect on semi-diurnal variation for such events, the semi-diurnal amplitudes are significantly higher for HAEs and significantly lower for LAEs as compared to the annual average values. No specific trends are visible, when we consider the differences in semi-diurnal phases for either of the station.

3. Conclusions

The high diurnal amplitude wave train events are generally associated with days of low to medium geomagnetic disturbances, whereas LAes are associated with moderate to high disturbances. The diurnal amplitude ratio's between Kiel and haleakala are slightly larger than the annual average values signifying softer rigidity spectral during HAEs. Moreover, HAEs show phase shift to earlier hours and LAEs to later hours as compared to annual average values.

4. Acknowledgment

We thank Prof. S. P. Agrawal, Ex vice-chancellor, A.P.S. University, Rewa for encouragement and useful suggestions.

References

[1] U. R. Rao et al., Planet Space Sci., 20, 1799 (1972).
[2] U. R. Rao et al., Solar Phy., 19, 209 (1971).
[3] S. Kumar et al., Bull. Astr. Soc. India, 21, 395 (1993).
[4] S. Kumar et al., Indian Journal of Radio & Space Phys. 25, 232 (1996).
[5] M. L Chauhan et al., Proc. 27th ICRC, SH,156 (2001).
[6] Ajay K. Pandey, Ph. D. Thesis, APS University, Rewa, India (2004).