EFFECT OF INTERPLANETARY TURBULENCES CAUSING UNUSUAL BEHAVIOUR IN CR INTENSITY

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Abstract

The unusually low as well as enhanced amplitude anisotropic wave train events in cosmic ray intensity have been investigated, using neutron monitoring data for different latitude. The enhanced amplitude events occur dominantly during the declining phase of solar activity, whereas, low amplitude events occur dominantly during minimum solar activity period. The Bz is found to remain +ve for majority of the days of the events, which shows that the occurrence of enhanced and low amplitude events is dominant during the positively directed IMF polarity. Further, during the period of events number of Interplanetary Magnetic Clouds have been identified using IMF and SWP parameters. The geomagnetic activity index-Ap is found to remain low during the period of events. The possible phenomenon to cause the enhanced as well as unusually low amplitude daily variation has been proposed to appear on the back side of the Sun.

1. Introduction

The solar diurnal variation of cosmic ray intensity shows a large day-to-day variability. This variability is a reflection of the continually changing conditions in the interplanetary space (Fluckiger, 1991). The systematic and significant deviations in the amplitude/phase of the diurnal /semi-diurnal anisotropy from the average values (Rao, 1972) are know to occur in association with strong geomagnetic activity (Mavromichalaki, 1980). The diurnal variation might be influenced by the polarity of the magnetic field (Parker, 1991). The largest diurnal variation is observed during the days when the daily average magnetic field is directed outward from the Sun. The changes have been observed in the amplitude and phase of high-speed solar wind streams (HSSWS) coming from coronal holes (Munakata et al., 1987). The average amplitudes of the first and second harmonics are found to be larger than normal during the initial phase of the stream, while it is smaller than normal during the decreasing phase of the stream and the phase is observed to be almost constant.

It has been observed that the amplitude of the diurnal anisotropy is sig-

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nificantly large during the three types of clouds (Klien and Burlaga, 1982), in comparison to the amplitude observed on geomagnetically quiet days. The phase has also been observed to be shifted to earlier hours during these clouds in comparison to the phase on geomagnetically quiet days (QD).

2. Data Analysis

The amplitude of the diurnal anisotropy on an annual average basis is found to be 0.4%, which has been taken as a reference line in order to select high /low amplitude events. The days having abnormally high/low amplitudes for a successive number of five or more days have been selected for study. The pressure corrected hourly neutron monitor daya, after applying trend correction, is harmonically analysed to have the amplitude (%) and phase (hr) of the diurnal and semidiurnal anisotropies of cosmic ray intensity of r high/low amplitude events. Further, the data related with interplanetary magnetic field (IMF) and solar wind plasma (SWP) along with geomagnetic activity index Ap and Dst have been investigated. Various features which are observed over the solar disk during the period of events have also been looked at.

3. Results and Discussion

It has been found that the amplitude of the diurnal anisotropy for every individual high amplitude event is significantly larger than the quiet-day annual average amplitude throughout the period of investigation (Fig. 1 a) and the phase of the diurnal anisotropy has shifted to hater hours for the majority of the events as compared to the annual average values (Kumar et al., 1993). The amplitude and phase of the diurnal anisotropy on a quiet-day annual average basis and for every individual low amplitude event have been plotted in fig. 1 b, which shows that the phase of the diurnal anisotropy has shifted to earlier hours as compared to a quiet-day annual average values for the majority of the low amplitude events.

Looking into the IMF and SWP parameters during the peirod of events number of interplanetary magnetic clouds (Zhang and Burlaga, 1988) have been identified. Thus the anisotropic wave train events may also occur during the period of magnetic clouds. Further, the z/t-test for distribution of solar wind velocity for three groups of days (high amplitude, low amplitude and quiet days) have been inverstigated for their significance. It was found that the lowest range of value of solar wind velocity is observed for low amplitude events, whereas slightly higher range is observed for high amplitude events. Further, the increase in solar wind velocity ranges has been found for quiet days, However, the z/t-test does not differentiat between the three groups of days. The significance is pronounced even at the 1% level in case of low amplitude evens and quiet-days.

The amplitude and phase of the diurnal anisotropy for each high/low am-

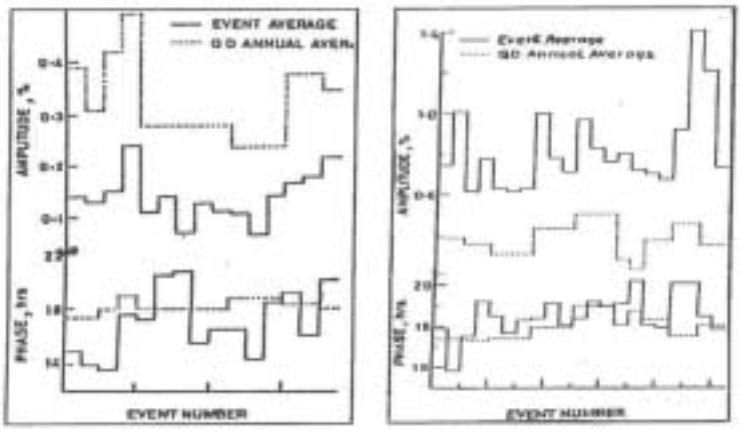

Fig. 1. (a) & (b) — Amplitude and Phase of the diurnal anisotropy for each LAE & HAE along with the quiet day annual average values.

plitude events has been plotted with the variation in associated values of the Z-component of the IMF, i.e., Bz in Fig. 2 (a) and (b).

The Bz is found to remain +ve for the majority of the days of the events of high/low amplitude events, which shows that the occurrence of these events is dominant during the positively directed IMF polarity. Further, the geomagnetic activity index Ap on an average basis remain low during the period of each event. This may be because the interplanetary disturbances responsible for cosmic ray modulation effects have not reached the Earth. The solar activity on the back side is not likely to produce the usual terrestrial manifestations such as geomagnetic storms, produced by activity on the visible side of the Sun. However, modulation by plasma clouds ejected from the back side and the subsequent propagation of cosmic ray particles might reveal such flare activity. If this is so, these events in the absence of geomagnetic storms/Forbush decreases may be used to infer the presence of solar activity on the hidded side of the Sun.

4. Conclusions

1. The occurrence of high/low amplitude events is dominant during the positively directed Bz-componant of IMF polarity.

2. The high amplitude events have occurred dominantly during the dectlining phase of solar activity, whereas the low amplitude events are more dominant during the peirod of minimum solar activity.

3. The geomagnetic activity index, Ap, has been observed to reamin low during the peirod of these events.

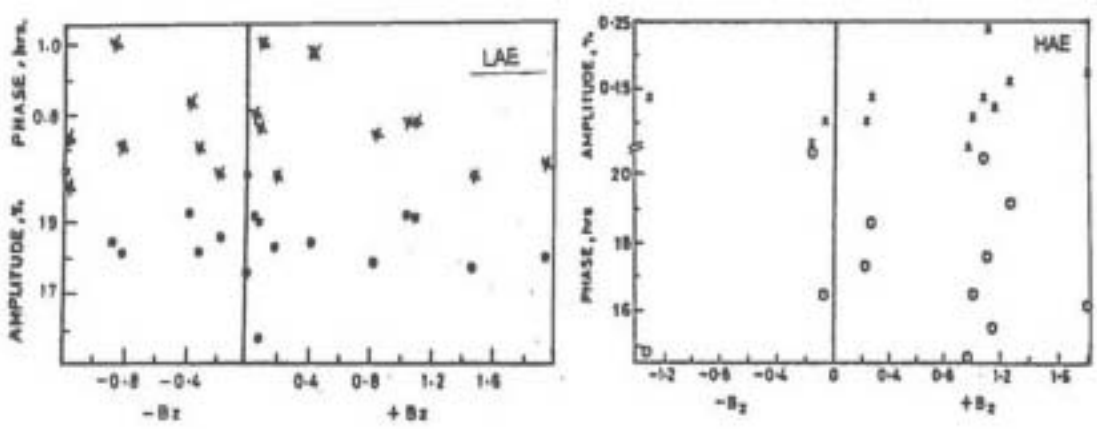

Fig. 2. (a) & (b) — Amplitude and Phase of the each LAE/HAE along with the Bz component of IMF.

Thus, one may conclude that the interplanetary turbulences responsible for cosmic ray modulation effects do not reach the Earth and the possible sources to cause the high/low amplitude events may be due to the intense solar activity on the backside of the Sun.

5. References

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