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A search for perpetrators causing ground level enhancements

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Ground level enhancement (GLE) is the sudden and sharp increase in cosmic ray intensity. GLE is believed to be occurred on solar cosmic rays. In this context, an attempt has been made to investigate the relationship of GLE with simultaneous solar, interplanetary and geophysical parameters, and thus searching parameters which seem to be responsible for causing GLEs. Followings are the results of our preliminary investigations into the GLEs having increase rate$>5\%$, and simultaneous solar, interplanetary and geophysical parameters for the period of 1996 – 2006.

- The total interplanetary magnetic field (IMF-B_{tot}) transported by the solar wind from the Sun may sometimes cause sudden increase in cosmic ray intensity because the correlations with peak (n$\leq$10) intensities of GLEs show sometimes direct proportionality to simultaneous IMF-B_{tot} (nT). Furthermore, the mean IMF-B_{tot} (9 nT) corresponded to peak (n$\leq$10) intensities of GLEs is stronger than the mean IMF-B_{tot} (6.78 nT) corresponded to the overall cosmic ray intensities. The magnetic fields were towards the Sun during the peaks of GLEs.

- There is no indication that geomagnetic storms have strong effects on the peaks of ground level enhancements. As found, during the peaks of cosmic ray intensities, geomagnetic disturbances are always weak (D_{st} >-40 nT).

- In most of the cases, solar wind plasma velocities (V_{sw} km/s) have positive correlation with GLE peak intensities indicating that interplanetary shock waves may increase the cosmic ray intensities. The mean speed of V_{sw} (1236 km/s) corresponded to GLE peak (n$\leq$10) intensities is much stronger than the mean speed of V_{sw} (449.80 km/s) corresponded to overall cosmic ray intensities. Our earlier reports also suggested that solar flares in conjunction with shock arrivals might cause sudden increase in cosmic ray intensities.

- Solar energetic particle (SEP) fluxes are always directly proportional to peak intensities of cosmic rays. This implies that intense solar energetic particle (SEP) fluxes may often be responsible for the sudden increases in cosmic ray intensities. Evidences are also supported by the fluences of SEP fluxes. For example, the mean fluence ($\sim$ 1.78 x10^6 cm^{-2}) of SEP flux >10 MeV across non-GLE event was much softer than the mean fluence ($\sim$ 4.53x10^7/cm^2) of SEP flux>10 MeV across GLE event.