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Effect of Solar Influence on Geomagnetosphere

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Abstract

An inter-comparison of the correlative analysis, we have taken daily value and yearly mean value of total interplanetary magnetic field B, solar wind speed (V), plasma electric field (V.B), sunspot number (Rz), geomagnetic index (Ap) and number of geomagnetic event (Ap 50 nT), for the solar cycle 22 to ascending phase of recent solar cycle 24, (Years 1986 - October 2013), 238 number of geomagnetic event are identified and a correlative study has been preformed. It has been found that the positively correlated between total interplanetary magnetic field (B), solar wind velocity (V), plasma electric field (V.B) with geomagnetic index (AP 50). We found that the plasma electric field (V.B) is the most effective parameter for producing larger geomagnetic disturbances.

Key words: Solar wind velocity, sunspot number, Interplanetary magnetic field, geomagnetic index.

Introduction

The main cause of intense GMSs is believed to be large IMF structures, which have an intense, long duration and south ward magnetic field component[8] Bz. They interact with the Earth's magnetic field and facilitate the transport of energy into the Earth's atmosphere through the reconnection process. In order to understand the response of the magnetosphere to IP conditions, interplanetary magnetic field strength (B) and (Bz) are investigated[13,15].

The solar – Terrestrial relationship includes the effect of solar output and its variations. It also includes propagational effects in the interplanetary medium, which ultimately produces disturbance in geomagnetic field. As such, the near earth interplanetary plasma and fields are expected to have a direct relationship with geomagnetic disturbance indices. In-situ measurements of IMF and solar wind parameters began in late 1962 and now cover more than four solar cycles. The observations have helped in establishing several useful statistical relationships between indices of geomagnetic activity and the causative parameters[17], including solar wind speed[19] V . The data have also been examined for their Long Term variability in terms of the eleven – year solar cycle component[2,5,12]. There fore, the characteristic variations of V, B, as well as of product V.B (plasms electric filed) have been examined in the understand their effect on the geomagnetic filed disturbances on statistical basis over a long period (1965-2006) Covering four solar activity cycles (20-23), Dwivedi, *et. al*.,[4].

Many others have in established some useful statistical relationship between geomagnetic activity indices and the causative solar wind parameters[9-11,14]. A long term trend in annual averages of as geomagnetic indices and solar wind parameters was observed attributed this decrease to a possible supernova explosion that may have occurred about 10^4 to $5x10^5$ years ago, but Ahluwalia,[1], offered a simpler explanation in terms of a systematic change in the magnetic state of the heliosphere as indicated by the base level of IMF intensity (B). Crooker, *et. al*,[3], shows that long –term averages of correlation between geomagnetic activity and solar wind velocity are indeed very striking. Sabban[16]; Singh, *et. al*.[18]; reported that the magnitude of the product VB rather than either solar wind speed or IMF strength B that directly modulate geomagnetic activity.

Data Analysis :

In our analysis the daily value and annual average of Interplanetary magnetic field B, solar wind speed (V), geomagnetic index (Ap), Plasma electric field (V.B) and sunspot number (Rz), have been used over the periods 1986 to October 2013, covering solar cycles 22 to ascending phase of current solar cycles 24. The daily value of solar and geomagnetic disturbance parameters have been taken from solar geophysical data books and data has been taken from the website www.ominwebgsfc.noaa.gov. Similarly, the geomagnetic index (Ap) have been downloaded from www.ngdc.noaa.gov. In this present study we have detect number of geomagnetic event (Ap 50) with respect Ap magnitude on the basis of this criteria that 238 event occurred during solar cycle, 22 to ascending phase of solar cycles 24.

Results and Discussion

Soon after the data for solar wind parameters were available, snyder, *et. al*., 1963 reported a good correlation between solar wind velocity (V) and the geomagnetic index (Kp) for individual geomagnetic storms lasting for a few tens of hours, magnetic field reconnection between the southwardly directed IMF and the geomagnetic field is the most widely accepted mechanism for magnetosphere energization. several coupling functions that correlate well between solar wind parameters and geo-magnetospheric dissipation parameters are used and these can be derived as particular cases of general expressions for the momentum and energy transfer at the magnetopause due to large scale reconnection[6,7] using the daily value of Ap 50, interplanetary magnetic field (B), solar wind speed (V), electric magnetic field (V.B), and annual mean value of geomagnetic index (Ap), sunspot number (Rz), are calculated for solar cycles 22 to ascending phase of recent solar cycles 24. which is occurred during 1986

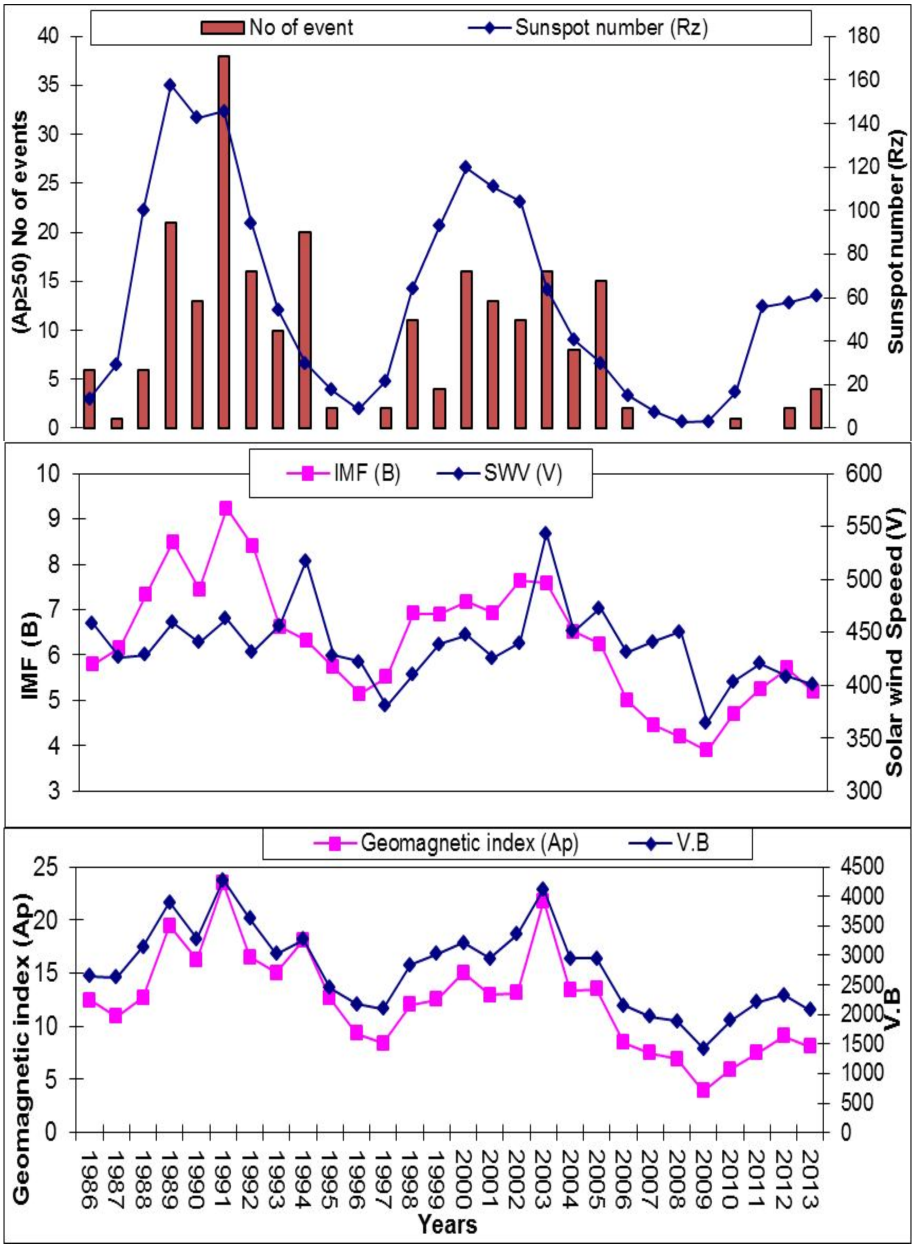

Figure 1: Shows the total number of geomagnetic events (Ap 50), annual mean value of sunspot number (Rz), annual mean value of interplanetary magnetic field (B), annual mean value of solar wind speed (V), annual mean value of geomagnetic index (Ap) and plasma electric field (V.B) during the solar cycle 22 to ascending phase of recent solar cycle 24 (1986 to October 2013).

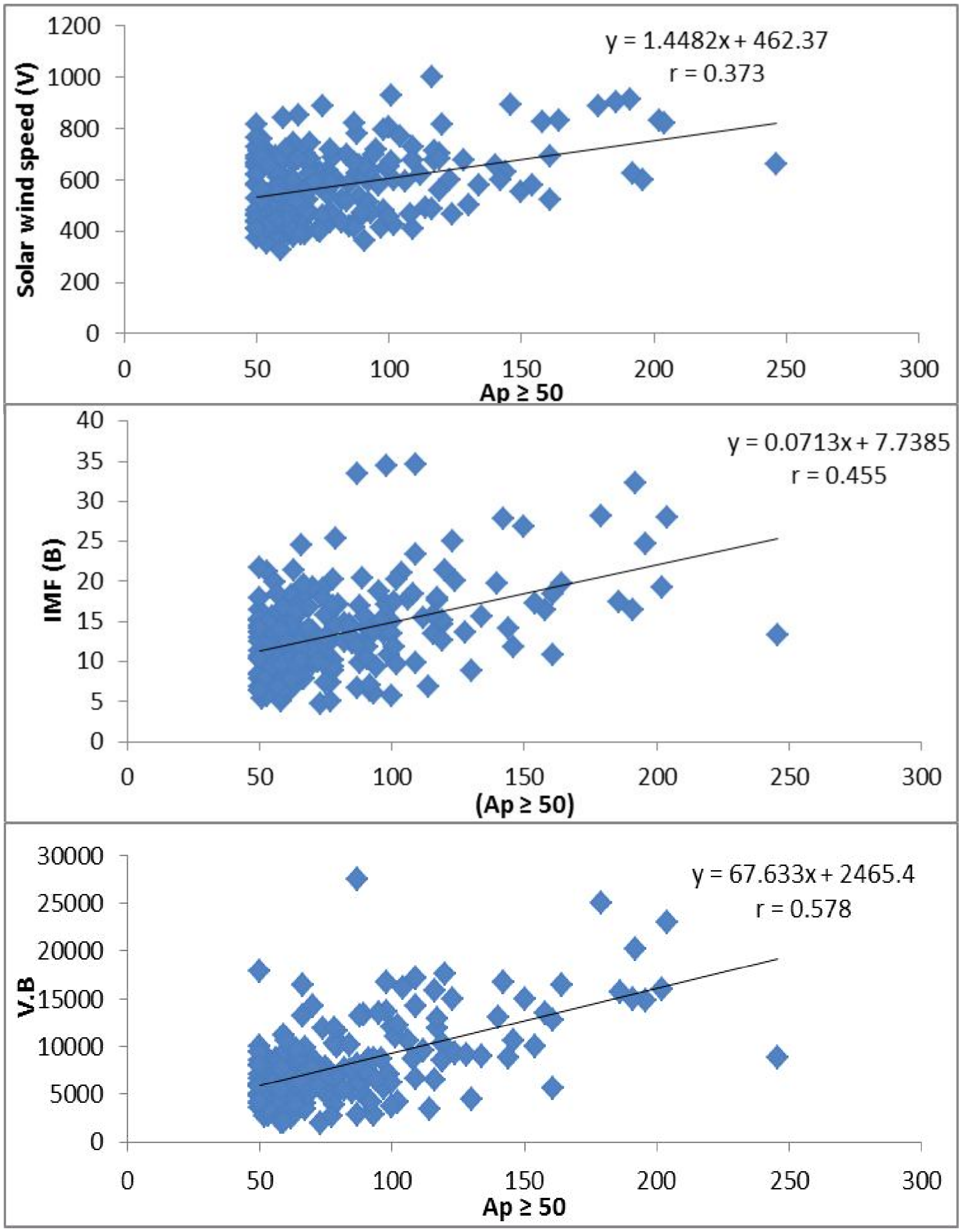

Figure 2: Shows cross plat between daily value of geomagnetic index (Ap 50) during events time with daily value of (V,B and V.B) during event period for the interval (1986 to October 2013).

to October 2013, based on 238 number of geomagnetic event (Ap 50). In figure 1, we shows the frequency distribution of the number of geomagnetic event (Ap 50) with annual average of sunspot number (Rz), annual value of interplanetary magnetic field (B), with annual value of solar wind speed (V) and annual value of geomagnetic index (Ap) with annual value of plasma electric field (V.B) for the periods fo 1986 to October 2013, (solar cycles 22 to ascending phase of resent solar cycles 24). Thus, we concluded that, geomagnetic events are highly correlated with sunspot number (Rz), figure 1, shows the maximum number of geomagnetic (Ap 50) events have occurred when sunspot number (Rz) are maximum in ascending phase of solar cycles 24, number of geomagnetic (Ap 50) event less than compared to ascending phase of another solar cycles 22 and 23, in figure 2, shows the geomagnetic event value (Ap 50) with solar wind speed (V), interplanetary magnetic field (B), and plasma electric field (V.B), during event periods for interval 1986 to october 2013, the cross correlation coefficient between (Ap 50) with V, (Ap 50) with B, and (Ap>, 50) with V. B have been found to be 0.373, 0.455 and 0.578 thus, we conclude that (AP 50) is good positive correlated with electric magnetic field (V.B).

Conclusions

* Number of geomagnetic storms (Ap 50) are minimum during the ascending phase of solar cycle 24 as compare to another ascending phase of solar cycle (22 to 23).

***** Geomagnetic event are highly correlated with sunspot number (Rz). It is maximum occurred during maximum and descending phase of solar cycles (cycle 22 to 23).

* Geomagnetic event (Ap 50) are highly effected by interplanetary parameters (V, B and V.B) during maximum and descending phase of solar cycles (cycle 22 to 23).

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