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Association of magnetic blobs with geomagnetic disturbances

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Interplanetary magnetic field is now known as one of the factor in interplanetary medium, which are associated with several solar and geomagnetic disturbances. Enhancement of magnitude of interplanetary magnetic field $\geq$ 9 nT, lasting atleast one day is called as a magnetic blob. The influence of magnetic blobs on geomagnetic field of earth has been studied for the period of 1997 to 2000. Daily values of geomagnetic disturbance index Ap are taken in chree analysis to investigate the influence of magnetic blobs on geomagnetic field variation.

1. Introduction

Sun related activity plays a significant role in producing several electric and magnetic processes, which in turn also affect the magnetic field of earth. Interplanetary magnetic field is known as one of the main factor in interplanetary space, which produces modulation in galactic cosmic rays as well as disturbances in earth magnetic field. Enhancement of magnitude of IMF > 9 nT is called magnetic blobs. In earlier studies, the southward component of IMF Bz and their fluctuations have been reported to be the most important parameters effecting the geomagnetic field variation [1]. Brouch and Burlaga [2] have reported the existence of a well-defined region of IMF exceeding the ambient field by a factor of 2-5, which some times last even for some days. Large numbers of magnetic blobs have been identified during the period of 1973 to 75. These magnetic blobs were found effective in producing large geomagnetic disturbances [3]. Singh et al [3] have identified 71 magnetic blobs adopting the slight different criteria. They have considered days of which IMF magnitude $\geq$ 10 γ (continuously for at least 4 hr a days), and correlated the magnitudes of these blobs against enhanced geomagnetic Dst values. In majority of cases, IMF blobs are associated with Dst enhancement. These IMF blobs are also found to be associated with cosmic ray decreases. They have also studied the effects of IMF (Bz) northward and southward components geomagnetic field and reported the ineffectiveness of northward components of IMF (Bz) in geomagnetic field variation. (The geomagnetic activity is generally represented by electromagnetic coupling V x B, where v is the velocity of solar wind streams and B is the IMF magnitude. The north–south component of IMF Bz plays a dominant role in determining the amount of solar wind energy to be transferred to the geomagnetosphere [4]. In this paper, we have made a systematic study to derive the association of IMF blobs with the geomagnetic field for the period of 1997 to 2000.

2. Discussion

The solar wind pulls the magnetic field of sun outside into the interplanetary space, which has been called interplanetary magnetic field. The days for which IMF magnitude $\geq$ 9 nT (continuously for at least one day) have been sorted out from the IMF (B) data get IMF data and plots have been taken from the omni data set

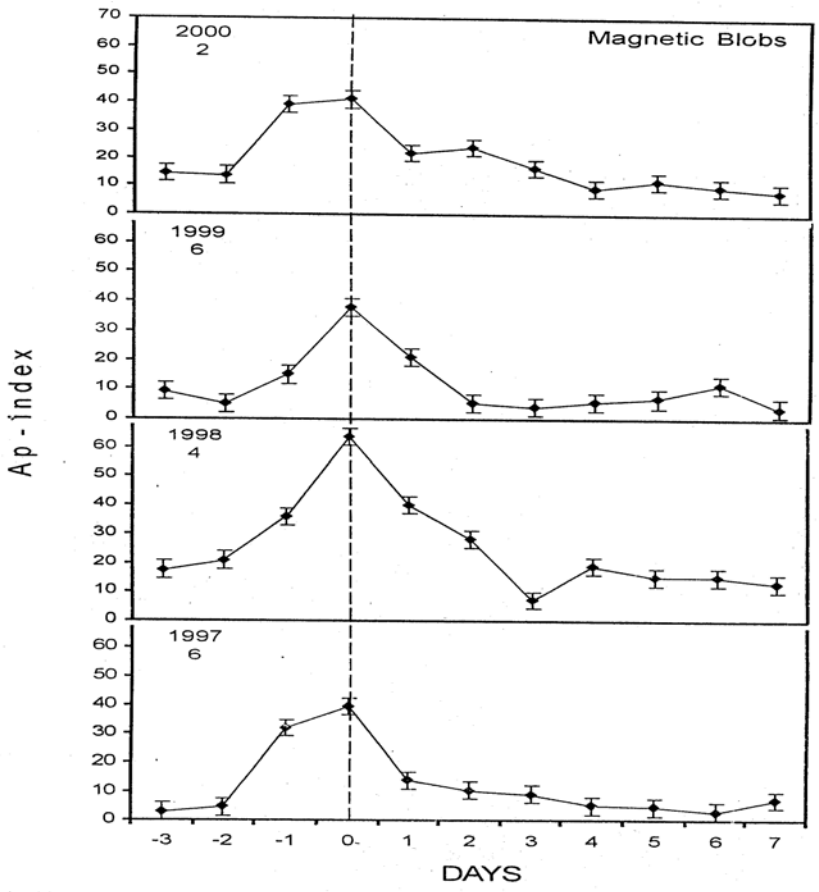

Figure 1. Shows the mean daily values of geomagnetic disturbance index Ap for a number of magnetic blob events (noted in parenthesis) superposed in the chree analysis for 1997 to 2000.

from the internet web site http://nssdc.gsfc.nasa-gov have identified 18 magnetic blobs for the period of 1997 to 2000. Figure 1 shows the results of chree analysis of superposed epoch to derive the effects of magnetic blobs on geomagnetic field of earth for number of events (noted in parenthesis). Daily values of Ap-index have been taken as the geomagnetic indices. The Ap–index, represents the intensity of planetary magnetic activity as seen in subauroral latitudes. The Ap–index in derived from the K–index. The K–index for each of the contributing mid–latitude geomagnetic observatories reflects the maximum range of any component of the field over the 3–4 time interval of each station. The Kp index is the average of K values from all contribution contributing observatories. A conversion scale of transforms the quasi–logarithmic Kp to a 3-hour Ap index expressed in units of 2p nT. A daily index Ap is obtained by summing the eight values of Ap for each day [5]. Zero days correspond to the starting day of magnetic blobs. It is observed from the figure that the magnetic blobs are effective in producing geomagnetic disturbances. We observed maximum geomagnetic disturbances on the date of emergence of magnetic blobs. Geomagnetic field starts to increase two days earlier from zero day and remain high two days after the epoch day. Such results are obtained all the years starting from 1997 to 2000.

The role of high-speed solar wind streams in geomagnetic field variation is also important. It has been reported that the high-speed solar wind streams generally produced increases in geomagnetic activity [6–7]. All these HSSWS are generally associated with high IMF values and southward components of IMF (Bz).
In the present study, it is found that enhanced Ap values are significantly associated with magnetic blobs. The results obtained from this analysis support the hypothesis of Barouch and Burlaga [2] qualitatively. Singh et al [3] obtained the increase in the Ap values with the increase in the magnitude of Southward Bz component. However, they did not observe all the southward Bz components with the increase of Ap values. Our results suggest that strong IMF is more likely to be cause of enhancement in geomagnetic level. In recent studies Coronal Mass Ejections are investigated as the main cause of geomagnetic disturbances [8–9]. The rate of reconnection of the magnetopause is thought to depend upon the magnitude of the interplanetary convective (V x B) electric field. Both the V and B tend to be high within the leading portions of interplanetary disturbances driven by fast CMEs so too does the convective electric field. Compression and draping of magnetic field lines edge of the CME and of the ambient IP field favours the condition for southward IMF, which produces large geomagnetic disturbances.

3. Conclusions

We have identified eighteen (18) interplanetary magnetic blobs during the period of 1997 to 2000. Magnetic blobs are found to be more effective in producing the enhancement in geomagnetic field of earth.

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