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Effect of polar coronal hole maximum intensity on geosphere during 1978–95

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The effect of Polar Coronal Hole Maximum Intensity (PCHMI), solar flares and active prominences and disappearing filaments (APDFs) on geosphere, during the period of 1978–95, has been investigated. In all, 176 geomagnetic storms (GMSs) of Severe (S), Moderately severe (MS) and Moderate (M) type with Ap>=20 have been considered. It is observed that the PCHMI events have occurred between 600 to 700 Polar Angle (PA) causing the GMSs of all types. It has been observed that 56%, 65%, 72% and 100% of total GMSs are associated with X-ray, H_α solar flares, APDFs and PCHMI respectively. Further, PCHMI has been observed to possess an excellent correlation with the occurrence of GMSs. However, the correlation coefficient is better in case of M-type GMSs followed by MS-type and S-type of GMSs. Thus, it is deduced from here that the PCHMI may be used as an important parameter in forecasting its effect on the Geospheric conditions.

1. Introduction

Solar wind, in the form of plasma embedded with the solar magnetic field, when interacts with geomagnetic field, causes disturbances in the geospheric sporadic phenomena have been observed on solar disc which affect the geospheric conditions and cause geomagnetic disturbances. Hewish and Bravo [1] found that geomagnetic storms are more associated with coronal holes than solar flares. Data available from skylab mission suggest that coronal hole, eruptive prominences and disappearing filaments (APDFs) have casual link with solar activity and produce GMSs. Further, in this paper, an attempt has been made to examine the effect of coronal hole maximum intensity and solar features that may cause GMSs.

2. Data Analysis

The solar features causing the severe ($H \geq 400nT$), moderately severe ($250 < H < 400nT$) and moderate ($H \leq 250nT$) geomagnetic storms with $A_p \geq 20$ during the period 1978–95 and total 176 GMSs have been investigated. For this, Solar Wind Plasma (SWP), Interplanetary Magnetic Field (IMF) data compiled by King and Papitashivili [2], in different volumes of Interplanetary medium data book from NSSDC and polar coronal hole intensity data compiled by A. Sanchez, Sonora Mexico are used. Analysis has been done by curve fitting method. On the basis of solar wind velocity, V, solar events have been investigated such that $1 \leq \Delta t \leq 5$ days prior to the occurrence of GMSs on the Earth. Here the time, Δt taken by solar wind in reaching the Earth from Sun will depend upon solar wind velocity, V. Further, the occurrence frequency of geomagnetic storms and disturbed days with polar coronal hole maximum intensity is considered for the entire period of consideration 1978–95.

3. Results and Discussion

The geomagnetic storms with planetary index $A_p \geq 20$ have been investigated for the period 1978–95 and selected 176 GMSs in different varying range of horizontal component of Earth's magnetic field (H).

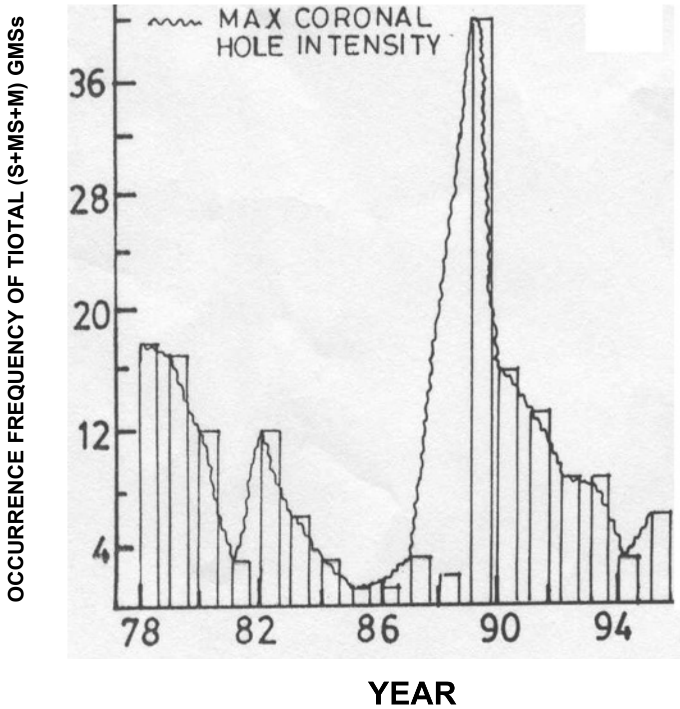

Fig 1: Occurrence frequency of Total (S+MS+M) type GMSs with polar coronal hole maximum intensity and their accumulated effects during the period 1978-95.

It is observed from Fig. 1 that 56%, 65%, 72% and 100% of total GMSs are associated with X-ray, H_α solar flares, APDFs and polar coronal hole maximum intensity respectively. Thus, it is inferred that polar coronal hole maximum intensity is found to possess a very strong correlation with GMSs. However, it is observed that correlation is better in the case of moderate GMSs. Further, Kumar and Yadav [3] have observed that maximum 71.5% GMSs are associated with solar flares during the period 1978–93. It has been observed from Figs. 2, 3 and 4 that polar coronal hole maximum intensity and solar wind velocity do not possess better correlation. Further, it is observed that there are many occasions when eruptive streams and shock are unaccompanied by flare or filament activity anywhere on the disc. Somehow, the polar coronal hole maximum intensity is being observed during this interval. Thus, it is concluded that high speed solar wind streams (HSSWS) originated from the coronal holes have much greater ability to produce GMSs. It has been observed that maximum number of GMSs occurred in the year 1989 during the entire period of considerations, i.e. 1978–95. Further, it is observed that CR intensity shows decrease, few hours earlier than the occurrence of GMSs. Badruddin [4] has observed that high speed solar wind streams associated with coronal holes have greater ability to reduce cosmic ray intensity. It is also observed that maximum number of polar coronal hole intensity events took place in between 60^0 to 70^0 polar

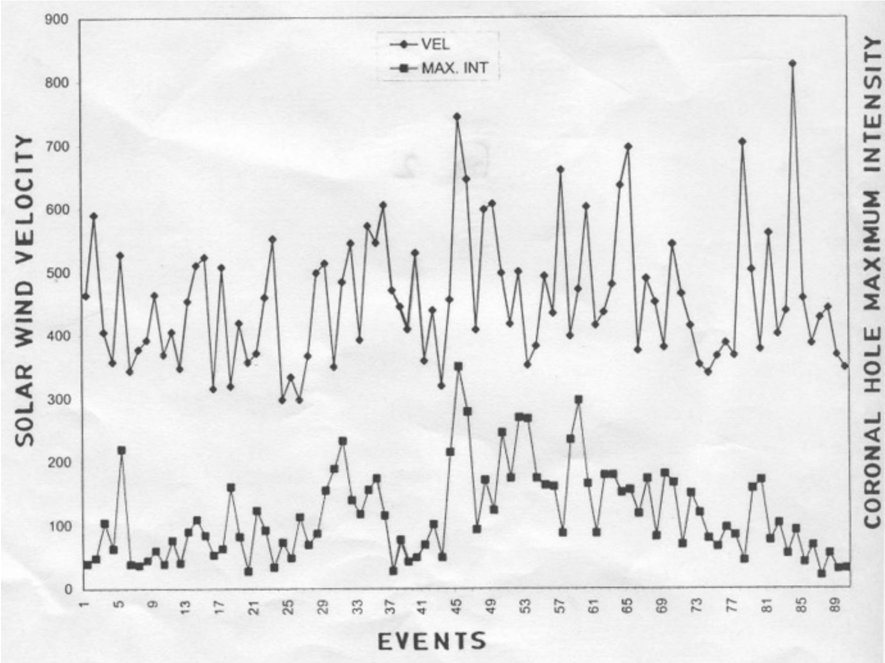

Fig 2: Solar wind velocity Vs coronal hole maximum intensity for moderate GMSs 1978-95

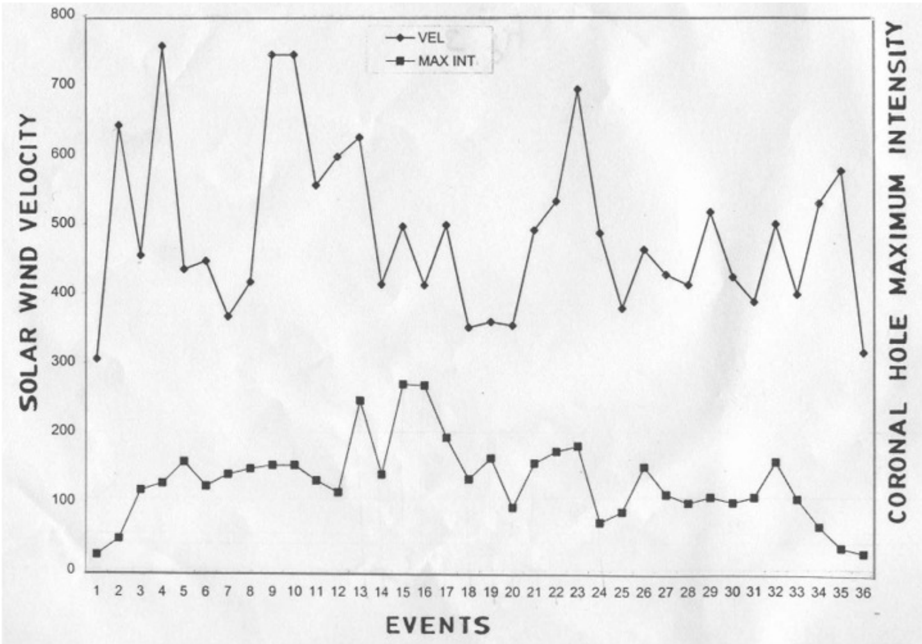

Fig 3: Solar wind velocity Vs polar coronal hole maximum intensity for severe type GMSs

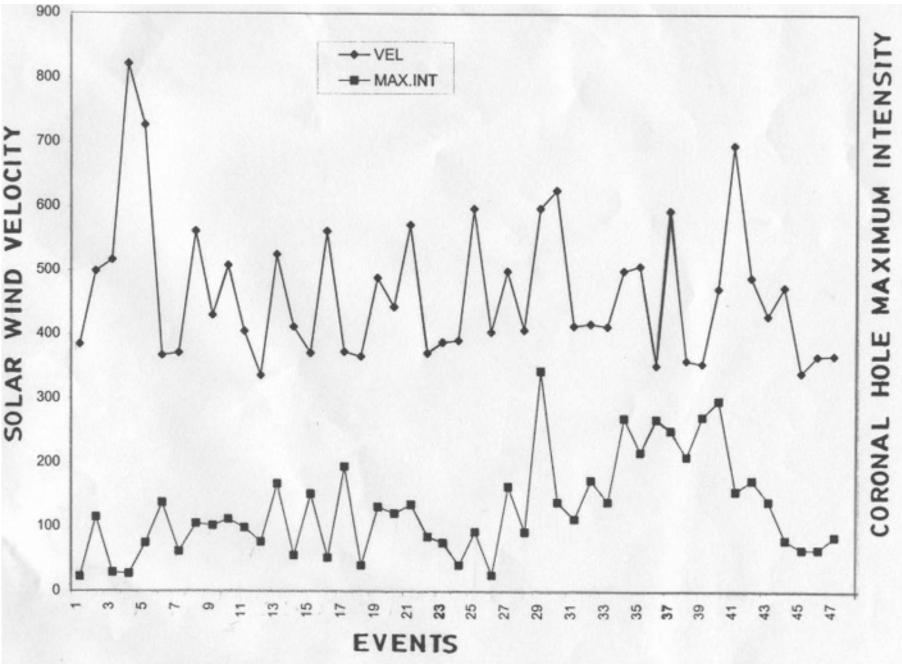

Fig 4: Solar wind velocity Vs coronal hole maximum intensity for moderately severe GMSs 1978-1995

angle which support the idea of Hundhausen [5], the coronal hole occur at low latitude and are always present in high latitude.

4. Conclusion

1. GMSs of all kinds are closely associated with polar coronal hole maximum intensity.
2. Maximum number of polar coronal hole maximum intensity events took place in between 60^0 to 70^0 PA.
3. High speed solar wind streams originated from coronal hole have ability to produce large GMSs.

5. Acknowledgement

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