
Study of Magnetic cloud and associated major geomagnetic storm.

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Abstract

In the present study almost all the magnetic clouds events occurred during the prescribed events 1996 – 2003 which covers whole period of solar cycle 23 have been taken into account. The selected storm events have been compiled and their various characteristics features as well as seasonal and solar cycle dependence have been discussed. We have extended our analysis to Cosmic Rays also on the basis of the various observational results and concepts. The world wide disturbances of the earth magnetic field which are of external origin are identified as a geomagnetic storm during which a significant depression D_{st} index occurs which is caused by an enhancement of the ring current of the magnetosphere. In order to find out the some of the solar interplanetary caused of geomagnetic storm; a study has been performed by selecting the storm on the basis of disturbance of storm time index D_{st}.

Introduction

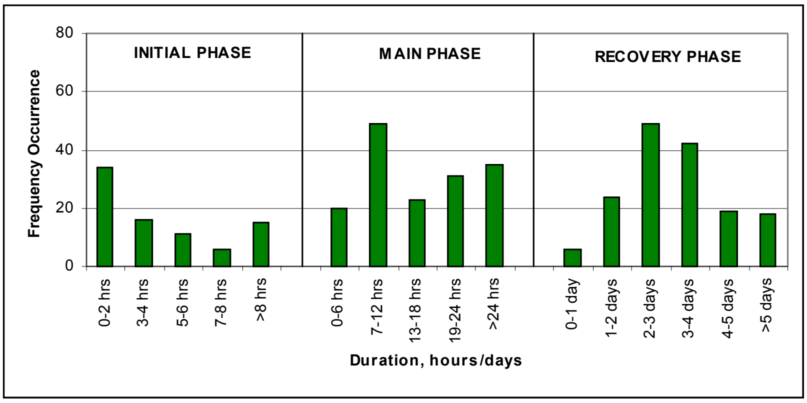
The aim of the statistical study presented in this paper is to analyze various characteristics of intense geomagnetic storms and which defines better aspects to understand history of geomagnetic storms. During geomagnetic storms, the magnetic field measured at the earth's surface is perturbed by strong electric currents flowing within both the magnetosphere and the ionosphere, the aurora brightens and extended to low magnetic latitudes, and intense fluxes of energetic charge particles are generated within the magnetosphere. The variation of earth's magnetic field, usually expressed through magneto grams, shows the time variation of declination D vertical component Z and horizontal component H. However, for global quantitative representation various geomagnetic indices have been introduced. The disturbance storm time (D_{st}) index is the conventional measure of ring current intensity and energy observed at earth's surface over low and moderate latitudes. The **D_{st}** values are obtained from the longitudinal average of H variations measured at middle and low latitude observatories.

Selection criteria and data source

We have analyzed all those intense geomagnetic storms which are associated with D_{st} decreases of more than 100 nT, and are observed during the period 1996-2003. This study is more useful to understand the physics of such events that makes one able to predict their occurrences. In this work, the beginning of the main phase of geomagnetic storms is reckoned on the basis of two time markers. One is associated with the storm sudden commencement (SSC) hour and another with the main phase onset (MPO) hour. The MPO is defined as the hour after which D_{st} values dip below the daily mean D_{st} of the previous day. The daily mean is generally near zero, but may occasionally be a few nT, positive or negative. The end of geomagnetic storms is considered till the period the hourly D_{st} values reach more or less a constant level for a few hours. However, the storm occurring in the recovery phase of the earlier event has been considered as another storm, provided that it is unambiguously observed in hourly plots and satisfies the criteria of selection.

Data, Detectors And Methodology

The Earth's magnetic field is being affected by various solar emissions as well as by interplanetary medium. These transient variations produce fluctuations in the ground-based



measurements of various geomagnetic field components, through the geomagnetic field measuring instruments. Geomagnetic variations are measured / recorded through the magneto grams. This chapter gives an introduction to these indices as well as about their measuring instruments / detectors. The general information about the various statistical methods is given in a separate section.

Fig-1 Frequency histogram for initial, main and recovery phase durations.

We have used the magnetic field and solar wind plasma measurements from *IMP* - 8 and *ISEE* – 3 spacecrafts provided by the National Space Science data Center. This chapter is dedicated to the data and the geomagnetic indices with a brief description of all the methods applied to analyse the data for the prescribed period. For this research work the time period selected is 1996-2003.The indices A_E, D_{st}, K_P, and A_p have been obtained from the libraries of *Indian Institute of Geomagnetism, Mumbai* and also from *National Geophysical Research Institute, Hyderabad.*

Conclusion

In a present study we have carried out various analysis on short term as well as long team basis. Various statistical method i.e. correlation coefficient regression analysis, pre analysis percent deviation etc. which are being generally used in space science research, have been applied to derive short term as well as behavior (Long term) of geomagnetic activity in relation with solar and interplanetary features. The main emphasis is given to magnetic cloud (MCE's) and by directional electron heat flux (BEHF) event . To analyse the geomagnetic activity associated with the structure present solar wind plasma and other interplanetary disturbance have used all the available solar interplanetary parameter and geomagnetic indices i.e. $D_{st,}$ A_p, K_p, A_e etc. These datas have been collected from various sources for the period of 1996 – 2003 covering the recent solar cycle 23. In situ spacecraft observations have been taken into account major interplanetary component. These datas are mainly available on Omni Web from observatory and from personal sources. However, at some places in order to analyse some occurred recently potentially geoeffective event and in order to find out some new possibilities. We have extended our analysis to Cosmic Rays also on the basis of the various observational results and concepts. The world wide disturbances of the earth magnetic field which are of external origin are identified as a geomagnetic storm during which a significant depression D_{st} index occurs which is caused by an enhancement of the ring current of the magnetosphere. In order to find out the some of the solar interplanetary caused of geomagnetic storm, a study has been performed by selecting the storm on the basis of disturbance of storm time index D_{st}.

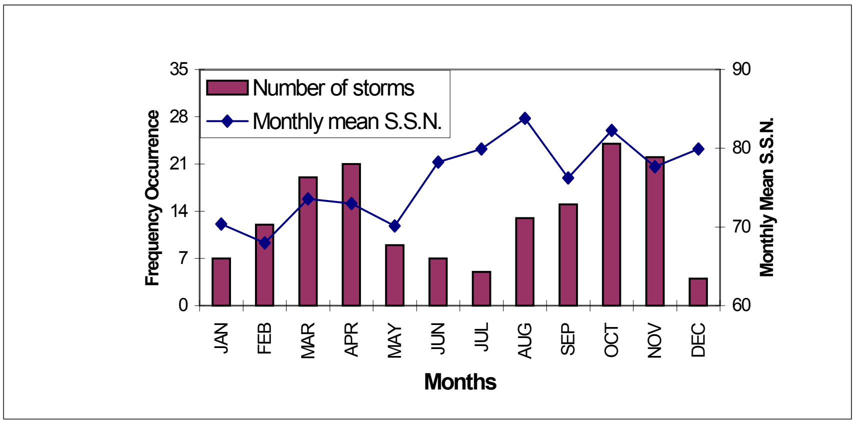


Fig. 2- Frequency histogram for seasonal dependence of large geomagnetic storms.

We have reached to the following conclusions –

1. In the present study almost all the magnetic clouds events occurred during the prescribed events 1996 – 2003 have been taken into account. We studied 47 magnetic clouds events among which 33 are negative clouds and 14 are positive magnetic clouds. Using superposed epoch analysis (Chree analysis) which D_{st} and interplanetary parameter, it is inferred that negative magnetic clouds are associated with significant decrease in geomagnetic field variation. Dst index is indicating its closed association in initiating a geomagnetic storm.
2. Interplanetary magnetic field B does not make sure any well defined various patterns during the passage of both kinds of magnetic clouds. It simply indicates an enhancement at the onset of both kinds of clouds reaching to its peak value with gradual decrease coming to it average values are ~ 4 days.
3. B_x component of interplanetary magnetic field indicates a decrease at the onset of positive as well as magnetic clouds. However, the decrease is sharp with early recovery in case of negative magnetic clouds laser decreases with slow recovery time is evident in case of positive magnetic cloud events.
4. B_y component of interplanetary magnetic field (IMF) shows enhancement during the passage of clouds larger fluctuations are observed in case of negative magnetic clouds events. In case of positive magnetic clouds event no significant change except several fluctuations are observed.

Acknowledgements

Authors is thankful to Prof. M.M.S. Tiwari and Prof. Arvind Tripathi of S.G.S. college Sidhi M.P. for stimulating discussions that resulted in the improvement of the paper.

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