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Study of Large Geomagnetic Storms and Variation Of Initial,Main,& Recovery Phases

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Abstract:-

A general study and different characteristics of above selected 158 large geomagnetic storms are performed in this section. Out of the selected large geomagnetic storm events, 82 are sudden commencement type and rest 76 is gradual commencement type. Geomagnetic storms are the most dramatic manifestation of solar-terrestrial coupling. They involve the injection of large amounts of energy from the solar wind into the earth's magnetosphere, ionosphere and thermosphere. There are number of solar sources, two types of solar wind streams and different interplanetary parameters that are responsible for geomagnetic storms have been investigated by many researcher. Recently,The geomagnetic disturbances can be observed at various locations of the earth's surface such as polar, mid-latitude and equatorial regions. These geomagnetic disturbances are generally observed and represented by different geomagnetic indices A_E, K_p or A_p and equatorial D_{st} values respectively.

Introduction:-

The coronal mass ejections and coronal holes are most violent solar source activities and are responsible for large geomagnetic storms. These solar transients can produce shock waves in solar wind. The shock waves travels in space in sunlit direction and interact with geomagnetosphere causes ionospheric disturbances, geomagnetic storms and auroral display. Geomagnetic storms also have major effects on technical systems in space. Many recent studies have shown that the sudden commencement storms are mostly associated with sudden storm commencement (SSC). In this communication, Lackner (1970) there are two types of geomagnetic field variations termed as long-term and storm-time variations. The long-term variations are very useful to solar cyclical study of geomagnetic field variation as well as change in polarity of Sun, climate change, plants

growth rate and geological change of earth's pole. Earth in 1958. The storm-time variations also known as geomagnetic storms deal the various characteristics of geomagnetic storms and their connection with solar source activities

Genearl characteristicof intense geomagnetic storms:-

These variations directly affect us and shows adverse effect in our satellites, communication system and power losses. Due to these effects, study of both types of variations is most important in the field of Geophysics. In this study, we have used various types of data to define both types of geomagnetic field variations. Different types of geomagnetic indices are used to calculate the change in geomagnetic field variations. Southward fields (Tsurutani et al., 1992; Gosling, 1993). The data of geomagnetic indices are available on different geomagnetic observatories which are situated in different location of earth's land surface. These geomagnetic disturbances are generally observed and represented by different geomagnetic indices A_E, K_p or A_p and equatorial D_{st} values respectively. This association is plotted in Figure 1 this figure shows that yearly occurrences of SSCs are actively follows with number of occurred sudden commencement storms in compression to all large geomagnetic storms.

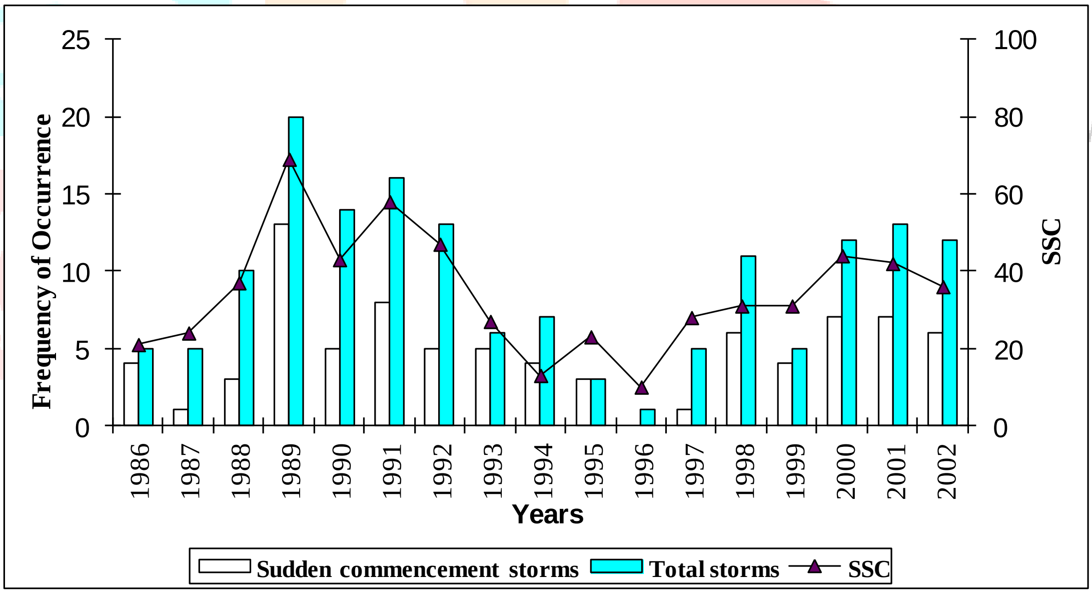

Figure 1. Shows the association of sudden commencement and large geomagnetic storms with sudden storm commencement (SSC) observed during 1986-2002.

Geomagnetic storms are large disturbances:-

The geomagnetic storms earth's magnetosphere, often persisting for several days are more. During geomagnetic storms, strong electric currents flowing within the geomagnetosphere and ionosphere. These currents perturb the magnetic field measured at the earth's surface, the aurora brightens and extended to low magnetic latitudes, and intense fluxes of energetic charge particles are generated within the magnetosphere. Solar output in term of solar plasma and magnetic field ejected out into interplanetary medium consequently create the perturbation in the geomagnetic field. When these plasmas and fields reach on the earth's magnetosphere produce extra ionization

in the sunlit part of the Earth and exhibit peculiar storm time changes in the geomagnetic field. The variation of earth's magnetic field is usually expressed through magnetograms of D, Z and 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. It is the best indicator of the ring current intensities and a very sensitive index to represent the degree of solar disturbances. The another geomagnetic index, auroral electrojet magnetic intensity index A_E which has been introduced by Davis and Sugiura (1966) is measured auroral electrojet intensity of the energy dissipated in the ionosphere and energy of precipitating electrons on the auroral and polar regions. The planetary or global

Zhu and Wada (1983) observed that the D_{st} value is minimum at about 10-20 hours after the occurrence of SSC. Moreover, a number of SSCs were not found to be associated with any significant change in the D_{st} magnitude. The onset time of geomagnetic storms is generally coincident with the time of SSCs (Agrawal and Singh, 1976), though it is not always an essential condition. In the present selected study period, 52% large geomagnetic storms were associated with SSCs. It is also observed that, in most of the cases, the onset of main phase just follows SSC. For the selected SSCs associated intense storm events, the most probable value of time difference between SSC and onset of main phase is found to vary from 0-2 hours, when the storms associated with SSC show faster recovery in comparison to the storms which are not associated with SSC.

A large number of geomagnetic storms occurred during the maximum phase of 11-year sunspot cycle because many solar activities are vastly occurring during this time. Near minimum phase of sunspot cycle, . Chree, C.1913 a few of the geomagnetic storms are observed due to the presence of coronal holes and some other solar activities. During our study period (1986-2002), the periods 1986-88 are taken as ascending minimum phase, 1992-99 are descending minimum phase and 2001-02 are the periods of ascending minimum phase of solar cycle 22nd and 23rd respectively. The period 1989-91 and 2000 are taken as the period of maximum phase of both solar cycles. Generally, solar cycle contains one maximum peak, where sunspot number is maximum and the period of that peak is termed as solar maximum phase. . Heikkila, W. J.1972The solar cycle 22nd exceptionally, among other 22 solar cycles, contains two peaks during the year 1989 and 1991. Therefore, the maximum phase of 22nd solar cycle has been measured during the year 1989-91. Figure 2. The association of large geomagnetic storms with annual mean sunspot number is depicted in This graph indicates the occurrence frequencies of sudden commencement storms,

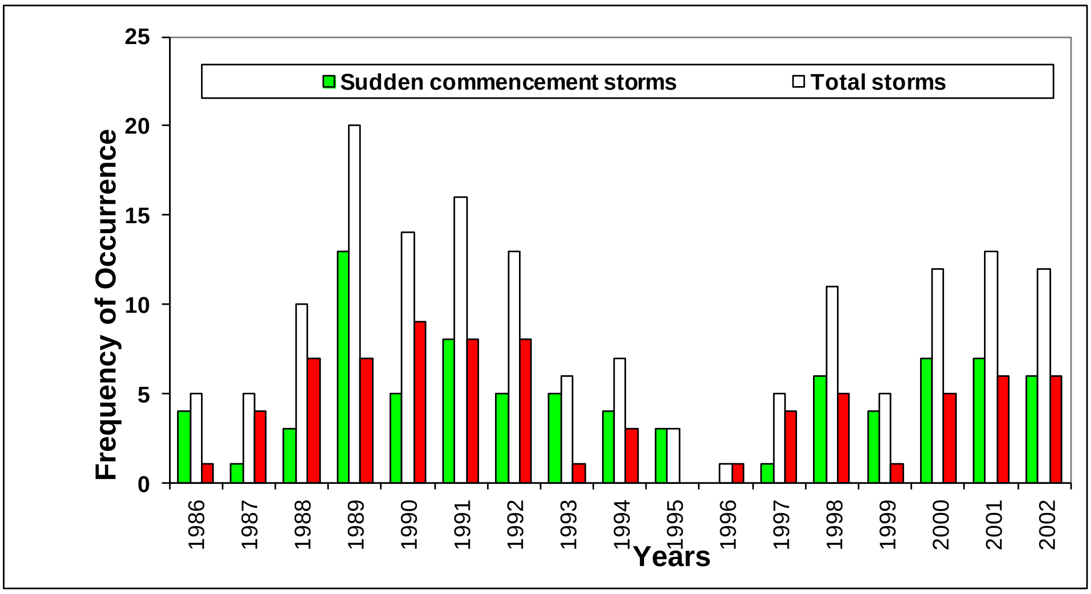

Figure 2.Shows the yearly occurrence of sudden commencement storm, large storms and gradual commencement storm observed during 1986-2002.

total number of large geomagnetic storms and gradual commencement storms, during the period 1986-2002. This plot which shows occurrence of large geomagnetic storm is strongly correlated with 11-year sunspot cycle, but no significant correlation between the maximum and minimum phases of solar cycle and the yearly occurrence of sudden and gradual commencement storms has been found.

Variation of initial, main, and recovery phase durations:-

A standard classical geomagnetic storm can be divided into three phases, namely initial phase, main phase and recovery phase. In this study, the best-fit initial, main and recovery phase durations have been analysed for above selected large geomagnetic storm events. Figure 3. Shows the compiled plots for initial phase, main phase and recovery phase durations. For the study of the initial phase duration, the number of such storm events have been selected whose initial phase duration varies in the time intervals of 0-2, 3-4, 5-6, 7-8 and > 8 hours. Similarly, for the main phase, time intervals of 0-6, 7-12, 13-18, 19-24 and > 24 hours have been selected.

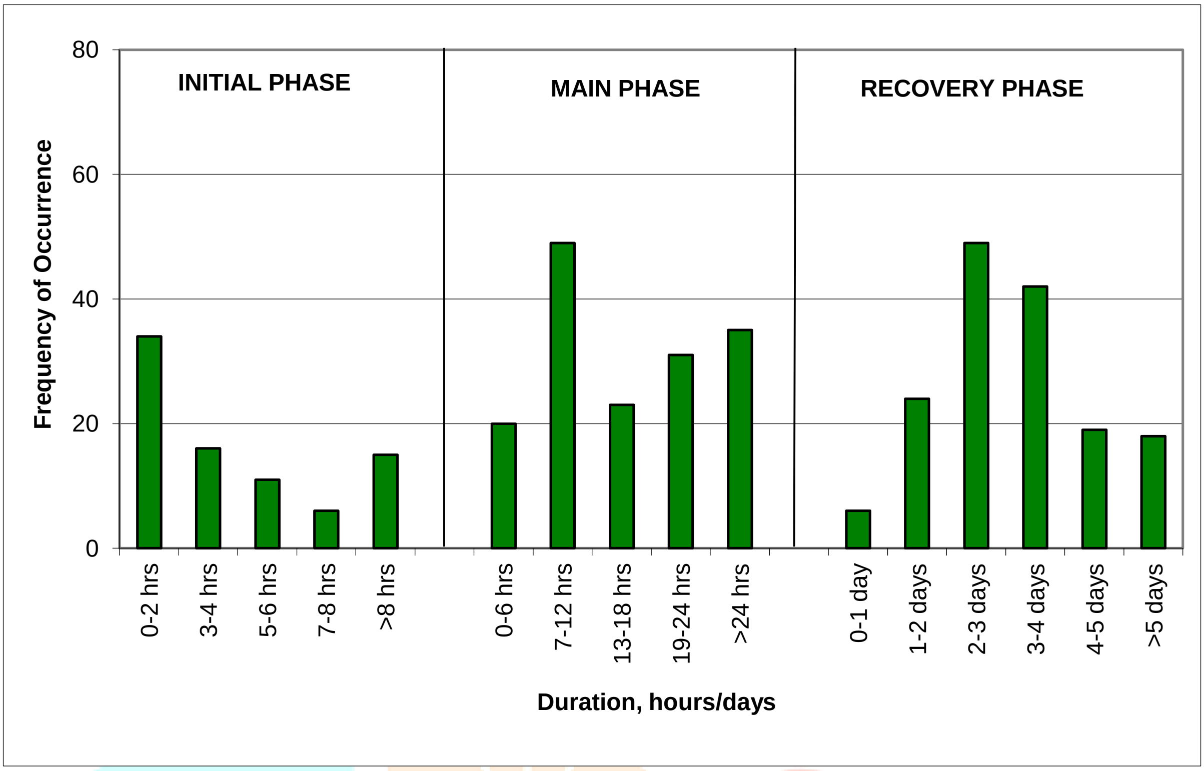

Figure 3.Frequency occurrence histogram shows the initial, main and recovery phase duration for selected 158 large geomagnetic storms in a specific range that is observed during 1986-2002.

Generally, the recovery phase of storms takes more time, so the time intervals varying in the range of 0-1, 1-2, 2-3, 3-4, 4-5 and > 5 days have been chosen. From these plots, it is clear that the best initial phase duration lies between 0 and 2 hours. The initial phase is caused by an enhancement of solar wind behind the shock wave. Tsurutani, B.T.1997 It is a quasi-steady state preceded by sudden storm commencement. The main phase duration for maximum number of intense storms lies between 7-12 hours. The main phase of the geomagnetic storm is characterized by the decrease in H-component of the earth's magnetic field and followed with the sudden ionospheric disturbances (SIDs) and ring current system. The recovery rate depends on magnitude and main phase gradient of storms. In this study, recovery phase duration lies between 2-3 days. Zhu, B. Y.1983 This phase follows with the active main phase and characterized by a slow and quiet return of H-field back to pre-storm level. It is also found that the main phase duration is always less than the recovery phase duration and the storm associated with SSC shows faster recovery in comparison to other storm that is not associated with SSC.

REFERENCES:-

1. Akasofu, S.-I. 1985 *J. Geophys. Res.*, 90, 325-40.Olmsted, C.Smith, E. J. Tsurutani, B. T. Okida, R. And Baker, D. N.
2. Agrawal, S. P.1976*Indian Journal of Radio and Space Phys.* and Singh, R. L. 5,330.
3. Allan, D. W.1962 *Proc. Cambridge Phil. Soc*. 58, 671.
4. Busse, F. H. 1975 *J. Geophys. Res.* 80, 278.
5. Chree, C.1913 *Phil. Trans. Roy. Soc. Lond.* A212, 76.
6. Heikkila, W. J.1972'*The morphology of Auroral Particle Precipitation*`, COSPAR, Space Research XII, (eds.) Bowhil et al., Vol. 2, pp.-1343, Akademie-Verlag, Berlin.
7. SGD *Solar Geophysical Data*, NOAA, U. S. Dept. of Comm. (Boulder, Co.) Monthly Report.
8. Tsurutani, B.T.1992 *Anne. Geophysica*, 10, 835-48.Gonzalez, W. D.Tang, F. and Lee, Y. T.
9. Tsurutani, B.T.1997 *The Interplanetary Causes of Magnetic* and Gonzalez, W. D.*Storms*, a Rev. in Geophys. Monogr. Series.
10. Zhu, B. Y.1983 *Proc. of 18th ICRC.*, Bangalore, MG-6-16, and Wada, M. 213.