Research Paper Physics

Occurrence of Geomagnetic Storms during the Solar Cycle 24

Bharti Nigam Research Scholar, Department of Physics, Govt. Auto. P. G. College, Satna, (M.P.)

P. K. Chamadia Department of Physics, Govt. Auto. P. G. College, Satna, (M.P.)

C. M. Tiwari Department of Physics, A. P. S. University, Rewa, (M.P.)

ABSTRACT *We examined the solar cycle distribution of moderate geomagnetic storms -100≤Dst<-50 (G1) including intense storms at the level of –200 nT≤ Dst <-100 nT (G2), great storms at –300 nT≤ Dst<-200 nT (G3), and super storms at Dst<-300 nT (G4), which occurred during the period of current solar cycle 24. Neither great storms (Dst < -200 nT) nor intense (Dst <-100 nT) storms of solar cycle 24 are found during the year 2008 to 2014. In our present study we see that Dst (nT) yearly average value is highly negatively correlated with yearly average value of Kp index with correlation coefficient r= -0.94 and with yearly average value of sunspot number (SSN) with correlation coefficient r = -0.60.*

KEYWORDS : Sunspot number, Distance storm time index (Dst).

INTRODUCTION

A geomagnetic storm is a disturbance in the Earth's magnetic field caused by interactions between materials ejected from the Sun and the magnetosphere. Major geomagnetic storms are among the most important space weather phenomena. What determines the physical laws describing the solar cycle distribution of major geomagnetic storms. Newton & Milsom (1954) investigated the solar cycle distribution of great geomagnetic storms that occurred during the period 1878–1952. They reported that most of the largest geomagnetic storms did not occur exactly at the peak phase of the cycles, but rather in periods a few years away from the peak on either side.

As it is well established, geomagnetic activity, as measured by indices such as Kp (Menvielle & Berthelier, 1991) and Dst (Sugiura, 1964), is principally driven by the plasma andmagnetic field conditions in the solar wind that encounters the Earth (Hirshberg & Colburn 1969; Arnoldy 1971; Tsurutani & Gonzalez, 1997; O'Brien & McPherron 2000; Ji et al. 2010). The major geomagnetic storm data are compared with the smoothed yearly mean sunspot numbers (SYMSNs) so that we can rigorously analyze the solar cycle distribution of major geomagnetic storms. The rate of storm days (defined by the NOAA G storm sizes) during the rise phase of each cycle is approximately correlated with the peak SSN in the cycle. If this relationship can be extrapolated to the lower storm rates found in cycle 24, they suggest values for the peak SSN in cycle 24that are consistent with the NOAA SWPC prediction, and indicate that cycle 24 is likely to be the weakest cycle since at least 1932 (Richardson, 2013). Yearly sunspot numbers are used to indicate the level of solar activity in this work.

Data analysis:

We used yearly average values of Dst-index, Sunspot number and Kp-index for the period 2008 to 2014.The basic data is mean daily value which are taken from OMNI web data explorer. Then we used statistical technique to correlate them.

Result and discussion

In our study we took daily Dst index (nT). Fig.1 which shows the yearly average value of sun spot number and yearly average value of Dst index. Fig.2 shows the graph between yearly average value of Dst index and Kp index. Fig.3 Yearly total number of G1 to G4 storm (per day analysis) during the first 7 years of solar cycles 23 and 24. It is clear that solar cycle 23 has more geomagnetic storms than that of 24 solar cycle.

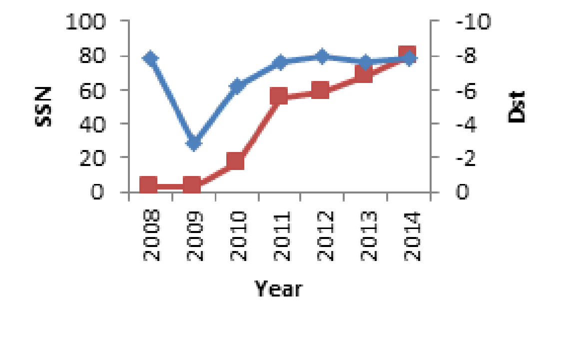

Fig 1- Shows the line graph between Yearly average value of Dst (nT) index and sunspot number for the period 2008-2014.

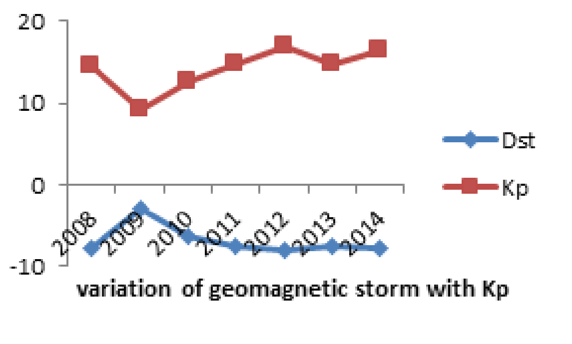

Fig 2 – Shows the line graph between Yearly average value of Dst index and Kp index for the period 2008-2014.

Conclusion

1. 25 moderate's geomagnetic storms are found in our selected period and there are no intense and upper geomagnetic storms during the period 2008 to 2014.
2. Dst index is highly negatively correlated (r=-0.94) with Kp index i.e. increase in Kp index Dst will more negative (more strong).
3. No vary good correlation is found between Dst index and SSN (r=-0.60).
4. According to first initial seven year solar cycle 24 is weaker than that of 23.

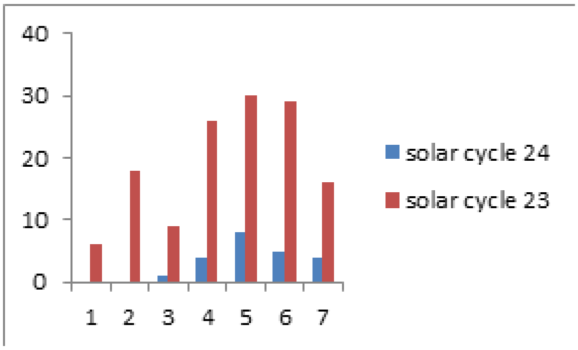

Fig 3- Yearly total number of Geomagnetic storms (Dst<-50) during the first 7 years of solar cycles 23 and 24;

REFERENCES:

1. Arnoldy, R. L., 1971, Signature in the interplanetary medium for substorms, J. Geophysics. Res.,76, 5189.
2. Hirshberg, J., and Colburn, D. S. , 1969, Planet Space Sci., 17, 1183.
3. Ji, E. Y., Y. J. Moon, and K. H. Kim, 2010, Statistical comparison of interplanetary conditions causing intense geomagnetic storms (Dst ≤ -100 nT), J. Geophys. Res., 115, A10232, DOI: 10.1029/2009JA015112.
4. Menvielle, M., and A. Berthelier, 1991, The K-derived planetary indices: Description and availability, Rev. Geophys., 29, 415, DOI: 10.1029/91RG00994.
5. Newton, H. W., & Milsom, A. S. 1954, J. Geophys. Res., 59, 203.
6. O'Brien, T.P., McPherron, R.L., 2000, An empirical phase-space analysis of ring current dynamics: solar wind control of injection and decay. Journal of Geophysical Research, 105, 7707-7719.
7. Richardson I.G., 2013, Geomagnetic activity during the rising phase of solar cycle 24. J. Space Weather Space Clim., 3, A08.
8. Sugiura, M., 1964, Hourly values of equatorial Dst for the IGY. Ann. Int. Geophys. Year 35, 9–45.
9. Tsurutani, B. T., Gonzalez, W. D., 1997, The principal interplanetary causes of magnetic storms, In: Magnetic Storms (eds) Tsurutani, B. T., Gonzalez, W. D., Kamide, Y., Arballo, J., American Geophysical Union, 98, 77.