wjert, 2022, Vol. 8, Issue 11, 59-65. *Original Article* ISSN 2454-695X

World Journal of Engineering Research and Technology

WJERT

www.wjert.org SJIF Impact Factor: 5.924

# CORRELATIVE STUDY OF SUNSPOT NUMBER WITH OTHER SOLAR AND GEOMAGNETIC PARAMETERS DURING 2012 – 2017.

**S.G. Singh*[1], N.K. Patel[2], S.C. Chaturvedi[3], Neelam Singh[4], P. R. Singh[5]**

[1,2]Dept. of Physics, Govt. P.G. College Panna (M.P.).

[3]Dept. of Physics, Govt. Lahiri College Chirimiri, Koriya (C.G).

[4]Dept. of Physics, Govt. College Malthon, Sager (M.P).

[5]Govt. P.G. College Panna, M.P.

**Article Received on 31/08/2022** **Article Revised on 20/09/2022** **Article Accepted on 10/10/2022**

***Corresponding Author**
**S.G. Singh**
Dept. of Physics, Govt. P.G. College Panna (M.P.).

## ABSTRACT

*When observing the sun with appropriate filtration, the most immediately visible features are usually its Sunspots, which are well-defined surface areas that appear darker than their surrounding because of the lower temperatures. Sunspots are regions of intense magnetic activity where convection is inhibited by strong magnetic fields reducing energy transport from the hot interior to the surface. The solar magnetic field gives rise to strong heating in the corona, forming active regions that are the source of intense solar flares and coronal mass ejections (CME). The largest Sunspots can be tens of thousands of kilometers across. In study obtain the yearly average data of different solar and geomagnetic parameters during 2012-2017, then draw correlative curve with each parameters and obtained positive and negative correlation between them.*

**KEYWORDS:** Sunspot Number (Rz), Disturbance in Storm time index (Dst), Solar wind velocity (V), Kp Index, Ap index and Radio Solar Flux (F-10.7).

## INTRODUCTION

Sunspots appear as dark spots on the visible surface of the sun. Temperatures in the dark centers of sunspots drop to about 3700 K (compared to 5700 K for the surrounding photosphere). They typically last for several days, although very large ones may live for several weeks. Sunspots are magnetic regions on the Sun with magnetic field strengths thousands of times stronger than the Earth's magnetic field. Sunspots usually come in groups with two sets of spots. One set will have positive or north magnetic field while the other set will have negative or south magnetic field. The field is strongest in the darker parts of the sunspots - the umbra. The field is weaker and more horizontal in the lighter part - the penumbra. The sunspot number is calculated by first counting the number of sunspot groups and then the number of individual sunspots. The "sunspot number" is then given by the sum of the number of individual sunspots and ten times the number of groups. Since most sunspot groups have, on average, about ten spots, this formula for counting sunspots gives reliable numbers even when the observing conditions are less than ideal and small spots are hard to see. Monthly averages show that the number of sunspots visible on the sun waxes and wanes with an approximate 11-year cycle. Intriligator (1977) defines a high speed solar speed streams as one having a rapidly rising increase in solar wind speed and peak velocity greater than or equal to 450Km/sec. Broussard et al (1977) define a high wind speed at a period in at which solar wind speed greater then equal to 450 Km/sec, when averaged over a day. Lind bland and Lundsiet (1981) published a high speed stream. Venkatensan et al. selected a high speed solar wind speed has one having rapidly rising increase over a short period reaching a maximum value of 550 Km/sec. Mavroni Chalaki et al. has compiled high solar wind stream. Solar radio brusti involving Longmuir waves which are driven by electron beam accelerated at shock. Cairns (1986) pointed out that in rest from propagation shock situation is qualitatively identical to earth Bo shock. Bale et al. 1999 provided first direct observation of energetic electron and brusti Longmuir wave in an active type 2$^{nd}$ source region. The average of eight values of ‘ap’ for a day is called the daily equivalent amplitude Ap. Degree of geomagnetic activity over the whole earth also represented by musical diagram.

The hourly Dst index (Sugiura, 1964) is obtained from magnetometer stations near the equator but not so close that the E-region equatorial electro jet dominates the magnetic perturbations seen on the ground. At such latitudes the H (northward) component of the magnetic perturbation is dominated by the intensity of the magnetospheric ring current. Dst index is a direct measure of the hourly average of this perturbation. Large negative perturbations are indicative of an increase in the intensity of the ring current & typically appear on time scales of about an hour. The decrease in intensity may take much longer, on the order of several hours. The entire period is called a magnetic storm.

**Observational Analysis**

In Correlative study obtain the yearly average values data of solar and geomagnetic parameters from 2012-2017, which are given in table.

| Years | SW Plasma Speed (V) (Km/sec) | Sunspot No. ( R) | Dst Index (nT) | Ap Index (nT) | Scalar Magnetic Field (nT) | Kp Index | Radio Solar Flux Index (F-10.7) |
|---|---|---|---|---|---|---|---|
| **2012** | 408.26 | 84.39 | -8.71 | 9.05 | 5.7 | 6.83 | 122.28 |
| **2013** | 396.72 | 93.69 | -7.8 | 7.56 | 5.18 | 14.75 | 122.49 |
| **2014** | 398.52 | 113.59 | -6.77 | 7.74 | 6.09 | 16.3 | 146.06 |
| **2015** | 437.17 | 69.69 | -15.46 | 12.22 | 6.68 | 21.19 | 120.15 |
| **2016** | 446.17 | 39.93 | -9.22 | 10.47 | 6.06 | 19.5 | 88.78 |
| **2017** | 454.65 | 21.81 | -9.37 | 10.34 | 5.24 | 18.92 | 77.33 |

From data analysis draw correlative curve between sunspot number and other solar and geomagnetic parameters then obtain correlation coefficient between them.

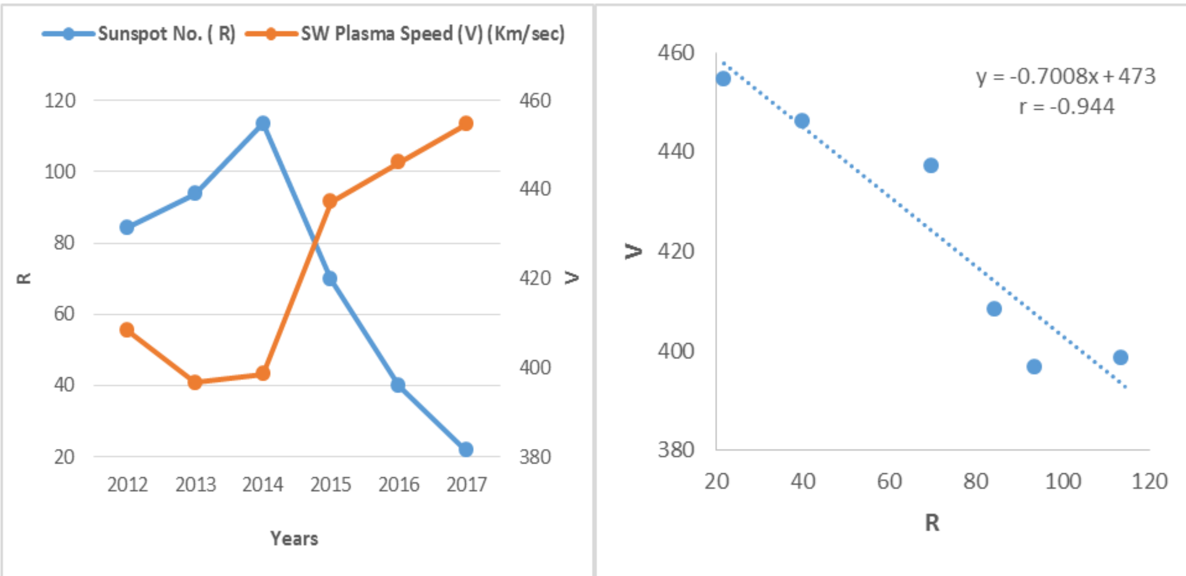
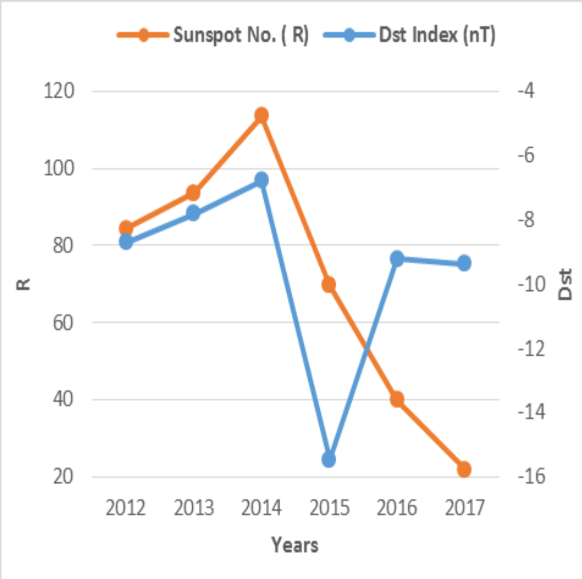



**Fig 1.1- Cross Correlation Curve between Sunspot number and solar wind velocity during 2012-2017.**

**Fig 1.2- Scattered plot between Sunspot number and solar wind velocity during 2012-2017.**



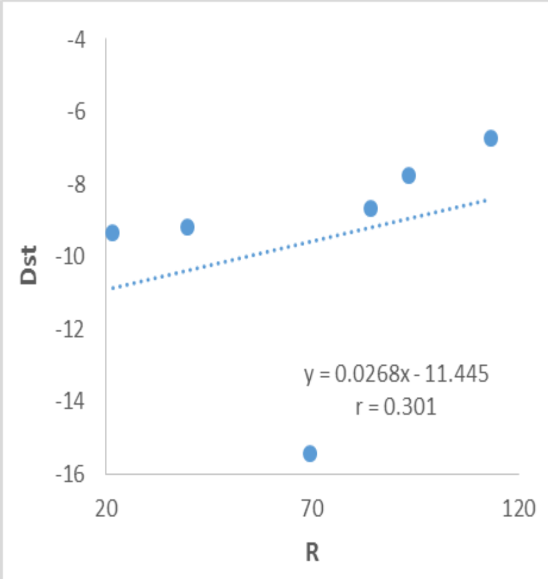
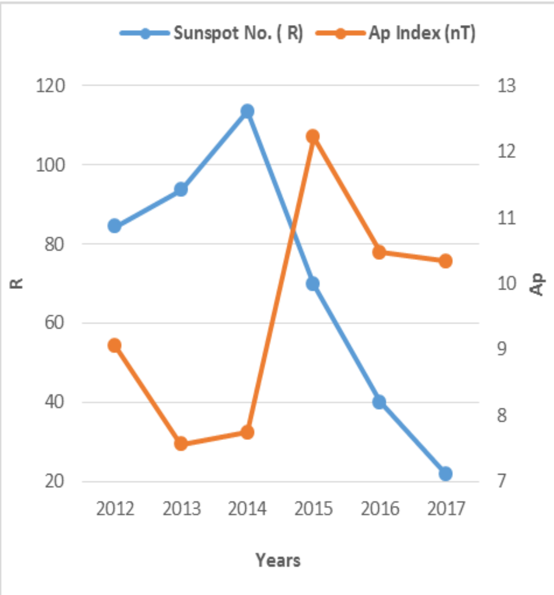




**Fig 2.1- Cross Correlation Curve between Sunspot number and Dst index during 2012-2017.**

**Fig 2.2- Scattered plot between Sunspot number and Dst index during 2012-2017.**



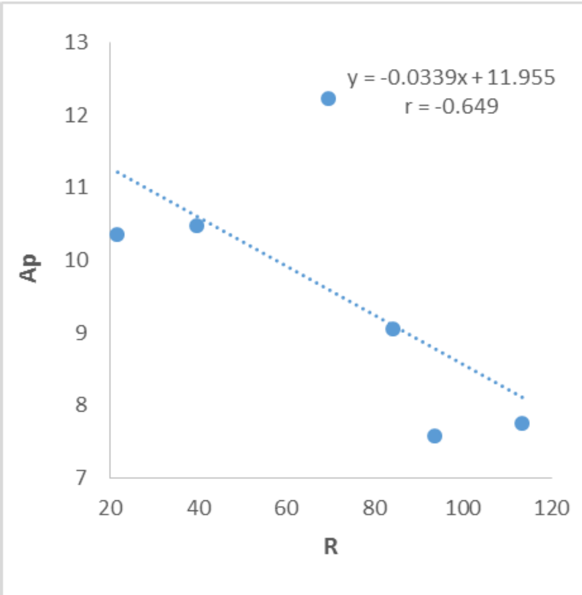
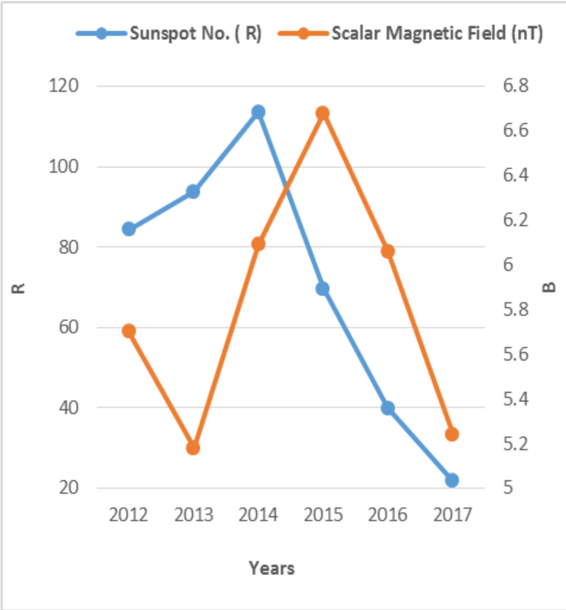




**Fig 3.1- Cross Correlation Curve between Sunspot number and Ap index during 2012-2017.**

**Fig 3.2- Scattered plot between Sunspot number and Ap index during 2012-2017.**



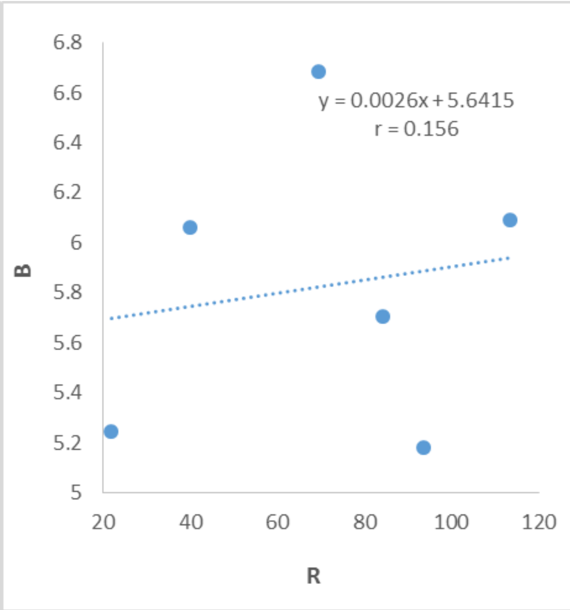
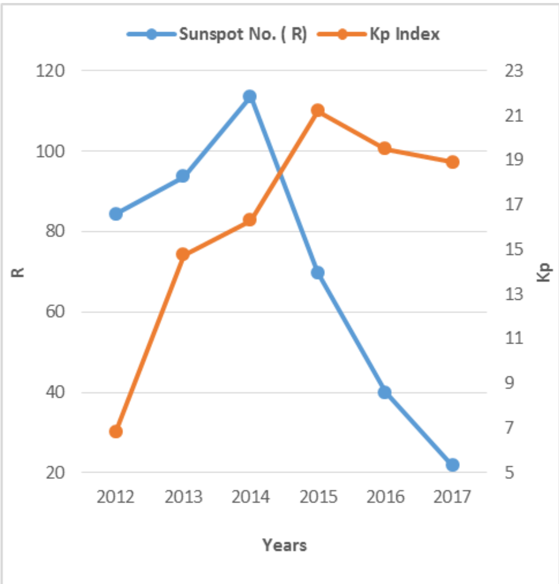




**Fig 4.1- Cross Correlation Curve between Sunspot number and Scaler Magnetic Field during 2012-2017.**

**Fig 4.2- Scattered plot between Sunspot number and Scaler Magnetic Field during 2012-2017.**



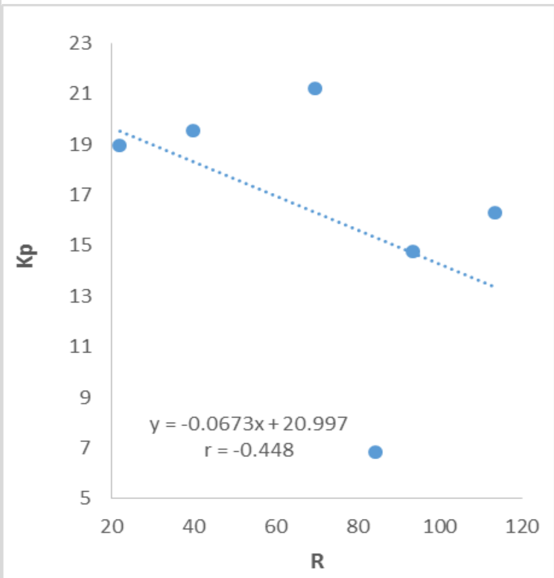




**Fig 5.1- Cross Correlation Curve between Sunspot number and Kp index during 2012-2017.**

**Fig 5.2- Scattered plot between Sunspot number and Kp index during 2012-2017.**

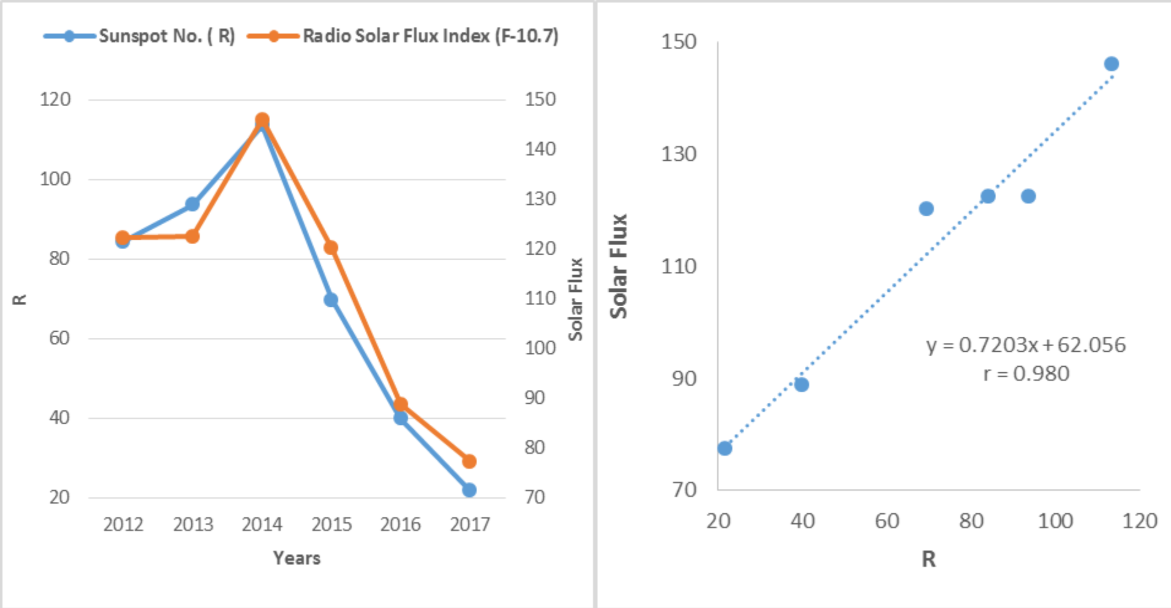



**Fig 6.1- Cross Correlation Curve between Sunspot number and Solar Flux (F-10.7) during 2012-2017.**

**Fig 6.2- Scattered plot between Sunspot number and Solar Flux (F-10.7) during 2012-2017.**

## RESULT AND DISCUSSION

in present analysis we have concluded running cross correlation between sunspot number and other solar and interplanetary magnetic field the correlation coefficient are found in given table:-

| **Sunspot No. (R)** | **Sunspot No. (R)** | **Sunspot No. (R)** | **Sunspot No. (R)** | **Sunspot No. (R)** | **Sunspot No. (R)** |
|---|---|---|---|---|---|
| SW Plasma Speed (V) (Km/sec) | Dst Index (nT) | Ap Index (nT) | Scalar Magnetic Field (nT) | Kp Index | Radio Solar Flux Index (F-10.7) |
| r = -0.944 | r = 0.301 | r = -0.649 | r = 0.156 | r = -0.448 | r = 0.980 |

In analysis correlation coefficient between sunspot number and solar wind plasma highly negative and sunspot number and radio solar flux is highly positive so our analysis indicate that solar activity indices are anti correlated with sunspot number and interplanetary magnetic field direct corrected with sunspot.

## CONCLUSIONS

In given analysis we have find that behaviour of all cross correlation curve coincides fairly well with each other.

**ACKNOWLEDGMENT**

The author thanks the word data centre a solar terrestrial physics and solar geophysical data comprises effect of providing data.

**REFERENCES**

1. Broussard,R.M. Sheeley,N.R., Tousey,R.and Underwood,j.H.; Stanford univ. Inst. For plasma Res. Rep. No. 696. 1977.
2. Cairns, I.H. J. Geophys. Res, 91: 2975. 1986b.
3. Intriligator, D.1977, in M.Shea et al. (eda.) Studey of Travelling Interplanetary.
4. Sugiura, M.; "Hourly values of equatorial Dst for IGY", Pergamon press, ox ford, 1964; **35:** 945-948.
5. Venkatesan, D.; Decker, R.B. & Krimigis, S.M. J. Geophys Res., 1984; **89**: 3735.