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ASSOCIATION BETWEEN GEOMAGNETIC Kp AND Ap INDEX WITH SOLAR AND INTERPLANETARY PARAMETERS

MUKESH KANWAL TRIPATHI[a], R.S. GUPTA[b1], P.L.VERMA[c] AND NISHANT KHARE[d]

[a]Department of Physics, Govt. P.G. College Satna, M.P., India
E-mail: mukeshtripathi000@gmail.com
[b]Department of Physics, Govt. P.G. College Satna, M.P., India[c]
E-mail: gpgcsatna@gmail.com
[c]Department of Physics, Govt. P.G. College Maihar, M.P., India
E-mail: pl_verma@yahoo.com
[d]Department of Physics A.P.S. University Rewa, M.P., India
E-mail: nishantkhare2008@rediffmail.com

ABSTRACT

Based on the monthly data of various solar and interplanetary parameters e.g. solar wind velocity, proton density, plasma temperature, IMF B(nt), sunspot numbers with geomagnetic index (Kp and Ap) from 1996 to 2009, detailed correlative study has been performed. We have reported the significant relationship among interplanetary plasma parameters for the 23 and rising phase of 24 solar cycles . We have also tried to investigate the correlative study of different solar and interplanetary parameters with Kp and Ap index. We have found that monthly average of geomagnetic index Kp and Ap are highly correlated with solar wind velocity, plasma temperature, IMF B(nt) while negative correlation between monthly average values of geomagnetic index Kp and Ap with proton density. We have also shows variation of geomagnetic indices with sunspot numbers and reported significant relationship between geomagnetic Kp and Ap index with sunspot numbers.

KEY WORDS: Solar wind velocity, proton density, plasma temperature, geomagnetic index

Various solar outputs occur on the surface of Sun, turn propagate their energy through solar wind and interplanetary magnetic field to long distance in heliosphere. These in turn affect the high energy cosmic ray particles as well as produce geomagnetic disturbances. The measurements of interplanetary magnetic field parameter and solar parameter started in the end of 1962. The studies of solar magnetic field have revealed that these fields change sign about every eleven year near the time of maximum solar activity, many investigators correlated geomagnetic indices Kp and Ap with the fluctuations of IMF, besides correlating with the solar wind velocity which in turn is related to diffuse component of convection-diffusion phenomena. A periodic fluctuation was observed in Ap index by Rangarazan and Iyemori, (1997).

There are different type of interplanetary parameters as solar wind velocity, density, temperature, IMF B(nt) and solar parameters as sunspot numbers are used. Several attempts have been made in past to draw the long-term relationship between solar & interplanetary phenomena and geomagnetic indices Kane (1972, 1974) Wilcox and Svalgaard, (1974). On the basis of statistical studies of the correlation between the Kp index and IMF B(nt)are reviewed by Hirshberg and Colburn (1969,1973). They have found strong positive correlation. They have found strong positive correlation. The solar terrestrial relationship has long been a topic of considerable significance in space plasma physics.

The data have examined for the long-term variation, either the eleven year solar cycle component King, (1979) and in term of quasiperiodic component such as 1 to 1.3 year oscillators in solar wind velocity Bolton, (1990) showed that when long-term averages are considered the correlation between geomagnetic activity and solar wind velocity is indeed very striking. He found significant variation from one cycle to next. In the present study, attempts have been made to find correlation between Kp and Ap index with sun spot number and interplanetary plasma parameters.

DATAANALYSIS

In present study we have considered data of geomagnetic Kp and Ap indices with solar and interplanetary parameters. Data of solar wind velocity, proton density, plasma temperature, IMF B(nt), sunspot numbers and geomagnetic Kp & Ap index monthly average values has been considered during 1996-2009. These data

[1]**Corresponding author**

has been taken from Omniweb site assembled by ACE (Advance Composition Explores) and Geophysical data book has been used for monthly average values of geomagnetic indices data.

RESULTS AND DISCUSSION

To study the relationship between solar wind velocity and Kp index, we have obtained the correlation of monthly average values of solar wind velocity and monthly average values of Kp index for the period of 1996 to 2009. Fig.1(a) shows that the higher values of Kp index are strongly associated with higher values of solar wind velocity and lower values of Kp index are strongly associated with lower values of solar wind velocity. Figure between these two parameter shows positive and high correlation with correlation coefficient = 0.77.

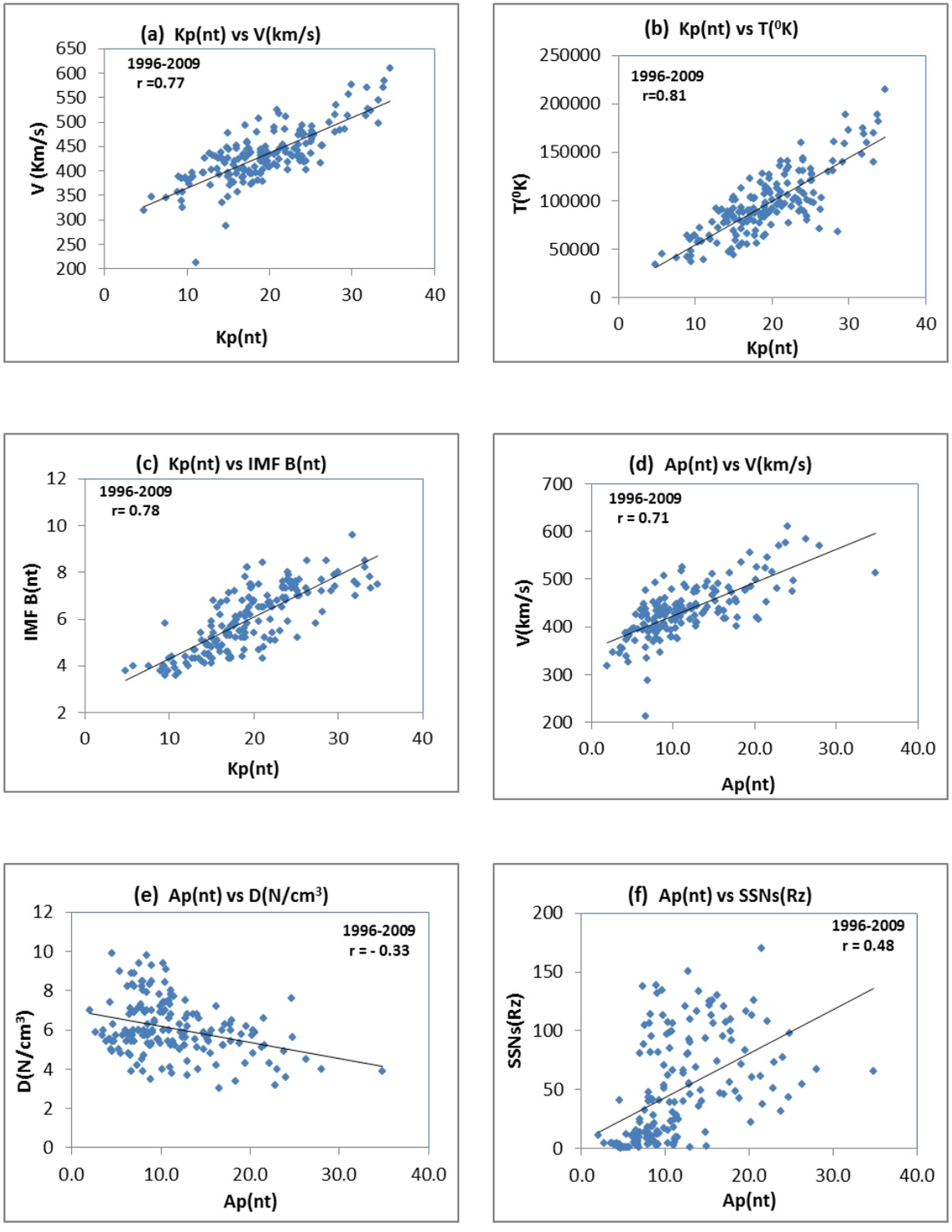
Fig.1(b) shows the correlation between monthly average values of Kp index and plasma temperature. This graph shows a strong positive correlation (coefficient=0.81). Fig.1(c) shows the correlation between monthly average values of geomagnetic Kp index and IMF B(nt). These parameters shows strong positive correlation with the correlation coefficient=0.78. Fig.1(d) shows the correlation between monthly average values of geomagnetic Ap index and solar wind velocity. Scatter plot shows the positive and high correlation between these two parameters with the correlation coefficient = 0.71. Fig.1 (e) shows the correlation between monthly average values of Ap index and monthly average values of proton density. It is clear that higher values of index Ap are associated with lower values of proton density and lower values of index Ap are associated with higher values of proton density. It means negative correlation between these two parameters with correlation coefficient = -0.33. Similar results are found between Kp index and proton density. Fig. 1 (f) shows the correlation between monthly average values of Ap index and monthly average values of sunspot numbers with positive and significant correlation. The correlation coefficient is =0.48. Fig. 2 shows the correlation between monthly average values of Kp index and monthly average values of sunspot numbers with positive and significant correlation (0.52). Fig. 3 indicates the yearly association of Kp and Ap index with sunspot number (Rz) which reveal that the value of Kp and Ap are higher during higher solar activity periods and these values decreases during ascending and descending phase of solar cycle 23.

CONCLUSION

On the basis of observational results and discussions, we have summarized important conclusions, which are as follows:

1. We have found that monthly average of geomagnetic Kp & Ap indices are highly correlated with solar wind velocity, plasma temperature, and IMF B(nt).
2. A negative correlation has been found between monthly average values of Kp & Ap indices with proton density.
3. A positive and significant correlation has been found between monthly average values of Ap index with sunspot numbers.
4. We have also found that yearly average value of geomagnetic Kp & Ap indices are high during higher solar activity period.

Fig.1 (a-f): Scatter plot between monthly average values of geomagnetic indices with solar and interplanetary parameters during 1996-2009



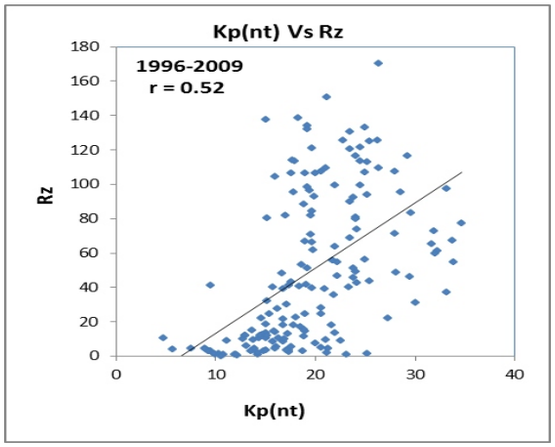


Fig. 2: Scatter plot between monthly average values of Kp with sunspot number during 1996-2009

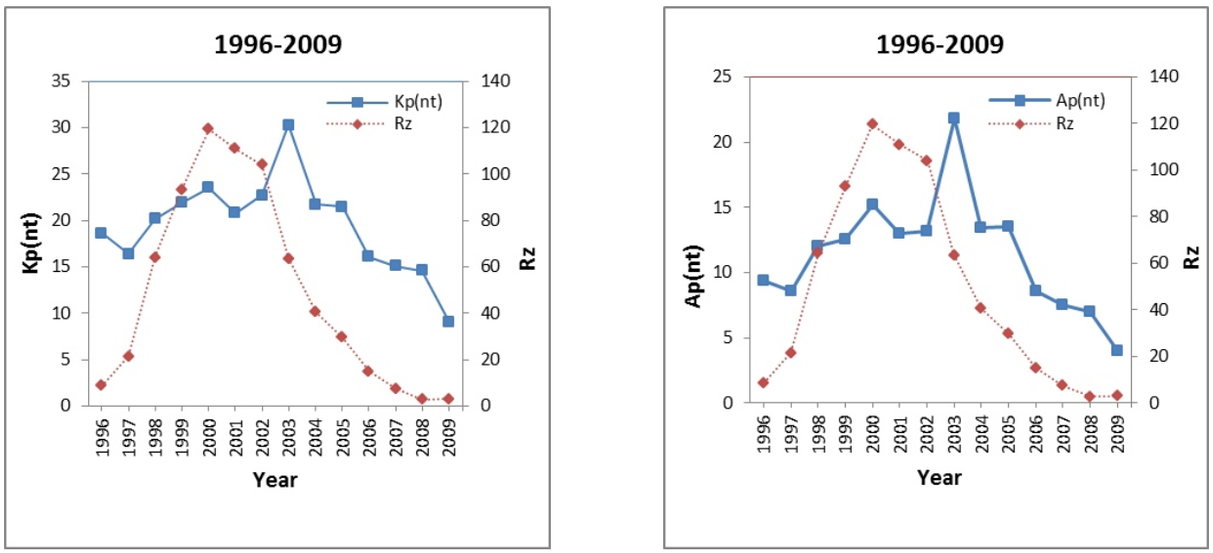


Fig.3: Shows yearly variations of Kp and Ap with sunspot numbers during 1996-2009

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