

# Correlative Study of SFI with Solar Wind Plasma Parameters & Interplanetary Magnetic Field

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**Abstract:** *In this paper we have considered yearly average value of solar flare index (SFI), interplanetary magnetic field (IMF) and solar wind speed (SWS) during the period of 2008 - 2018. We have analyzed correlative study of solar flare index (SFI) with interplanetary magnetic field (IMF) and solar wind speed (SWS). During significant and variation trend in periods of these geomagnetic indices we have observed the changes in solar wind plasma parameters (SWS) and interplanetary magnetic fields (IMF). After observing all variations in study periods we have showed association and correlation between geomagnetic indices with solar/interplanetary plasma parameters. On the basis of observational results and discussions, we have drawn important results and conclusions.*

**Keywords:** Solar Flare Index (SFI), IMF and SWS

## 1. Introduction

The solar variations are transported to the Earth through the solar wind, solar energetic particles, and solar radiation. The 11 - year periodicity has been observed in most solar wind parameters, such as the interplanetary magnetic field (IMF) magnitude (King, 1979), the IMF  $|B_z|$  and the helium content (Aellig et al., 2001; Neugebauer, 1981) almost from the start of the space era. A similar periodicity was found in the solar wind plasma parameters, for example, density and velocity (Dmitriev et al., 2009). However, the cycles of solar wind parameters and indices of geomagnetic activity might not have the same phase or shape as the sunspot cycle (Feynman, 1982; Hirshberg, 1973). Several investigators studied long - term variations in the solar wind velocity and the open solar magnetic flux by making reconstruction of the velocity from the geomagnetic indices (Lockwood et al., 2009; Rouillard et al., 2007). From the early observations of solar wind bulk speed, Snyder et al. (1963) were able to establish its close correlation with geomagnetic activity. Crooker et al. (1977) showed that when long term averages (covering duration of 6 months or more) are considered, the correlation between geomagnetic activity and solar wind velocity is indeed very striking. The averaged solar wind velocity and IMF magnitude obtained from in situ data between 1965 and 2010 were presented and discussed by Zerbo et al. (2013). This study also indicated significant variations in the solar wind speed which generally match the variations in the *aa* index. (Dmitriev et al., 2005) analyzed solar wind plasma and magnetic field properties during four solar cycles from 20th to 23rd.

## 2. Data and Analysis

Here we have taken yearly data of Solar Flare Index (SFI), interplanetary magnetic field (IMF) and solar wind plasma parameters from Omni web data explorer (<https://omniweb.gsfc.nasa.gov/form/dxi.html>) during the period of 2008 - 2018. The correlation coefficient between Solar Flare Index

(SFI) and different solar activity parameters has also been calculated for the Said period using the method of "minimizing correlation coefficient method". In this paper we will find the correlation between Solar Flare Index (SFI) with interplanetary magnetic field (IMF) and Solar Wind Speed (SWS) during the period of 2008 - 2018.

## 3. Results and Discussion

### Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF)

From the study we have plotted a linear diagram, in which shows the variation of yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF) for the period 2008 - 2018, it is shown in fig.1. From the figure is observed that although yearly average value of Solar Flare Index (SFI) varies according to the variation in yearly average of Interplanetary Magnetic Field (IMF) and it is clear that variation of higher values of Solar Flare Index (SFI) with higher values of Interplanetary Magnetic Field (IMF) and the same variation of lower values of Solar Flare Index (SFI) with lower values of Interplanetary Magnetic Field (IMF). Positive correlation with correlation coefficient 0.71 has been found between the yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF).

And we have plotted a scatter diagram between the yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF) and the resulting diagram is shown in fig.2. From the figure it is clear that higher values of Solar Flare Index (SFI) are generally associated with higher values of Interplanetary Magnetic Field (IMF) and lower values of Solar Flare Index (SFI) are generally associated with lower values of Interplanetary Magnetic Field (IMF) but these two events do not have any quantitative relation their amplitude do not have any fixed proportion. We have found some Solar Flare Index (SFI) which have higher values but they are associated with Interplanetary Magnetic Field (IMF)

which have lower values. Positive co - relation has been found between the yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF). Statistically

calculated co - relation co - efficient is 0.71 between these two events.

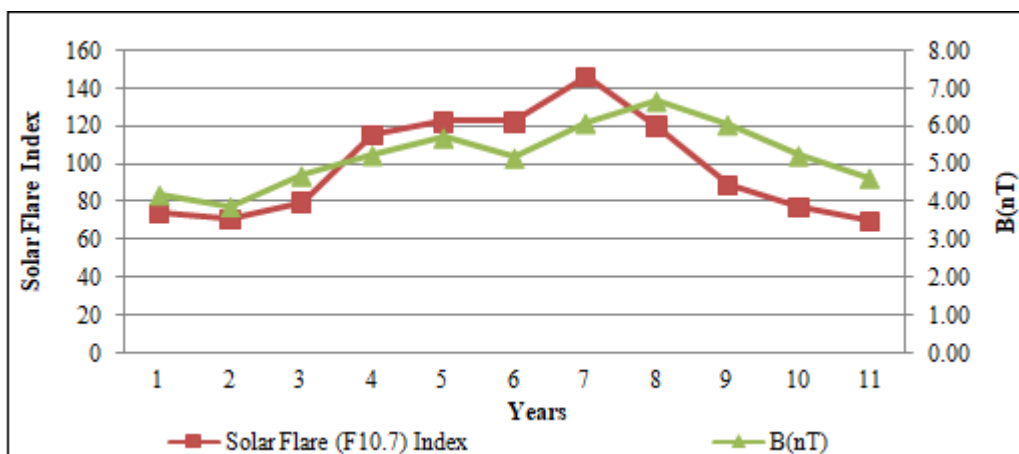


Figure 1: Shows the linear diagram between the yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF) for the period 2008 - 2018. Correlation coefficient is = 0.71.

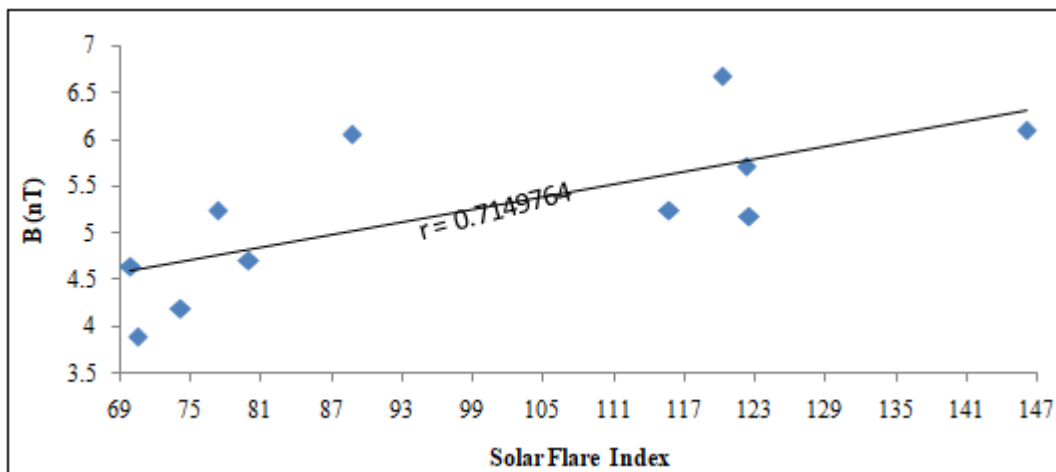


Figure 2: Shows the scatter plot between the yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF) for the period 2008 - 2018. Correlation coefficient is = 0.71.

**Solar Flare Index (SFI) and Solar Wind Speed (SWS)**

From the study we have plotted a linear diagram, in which shows the variation of yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS) for the period 2008 - 2018, it is shown in fig.3. From the figure is observed that although yearly average value of Solar Flare Index (SFI) anti phase of the yearly average of Solar Wind Speed (SWS) and it is clear that variation of higher values of Solar Flare Index (SFI) with lower values of Solar Wind Speed (SWS) and the same variation of lower values of Solar Flare Index (SFI) with higher values of Solar Wind Speed (SWS). Negative correlation with correlation coefficient - 0.34 has been found between the yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS).

And we have plotted a scatter diagram between the yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS) and the resulting diagram is shown in fig.4. From the figure it is clear that higher values of Solar Flare Index (SFI) are generally associated with lower values of Solar Wind Speed (SWS) and lower values of Solar Flare Index (SFI) are generally associated with higher values of Solar Wind Speed (SWS) but these two events do not have any quantitative relation their amplitude do not have any fixed proportion. We have found some Solar Flare Index (SFI) which have higher values but they are associated with Solar Wind Speed (SWS) which have lower values. Negative co - relation has been found between the yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS). Statistically calculated co - relation co - efficient is - 0.34 between these two events.

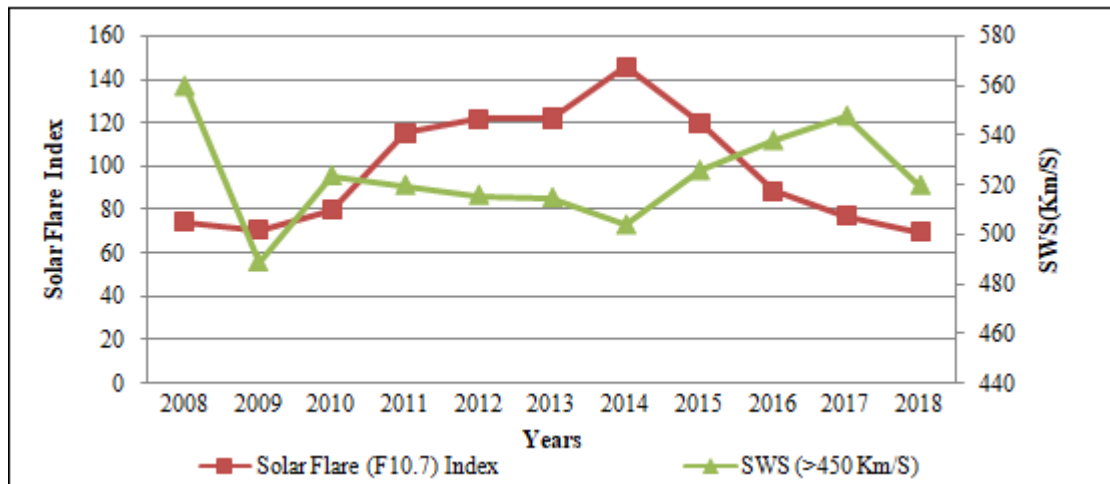


Figure 3: Shows the linear diagram between the yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS) for the period 2008 - 2018. Correlation coefficient is = - 0.34.

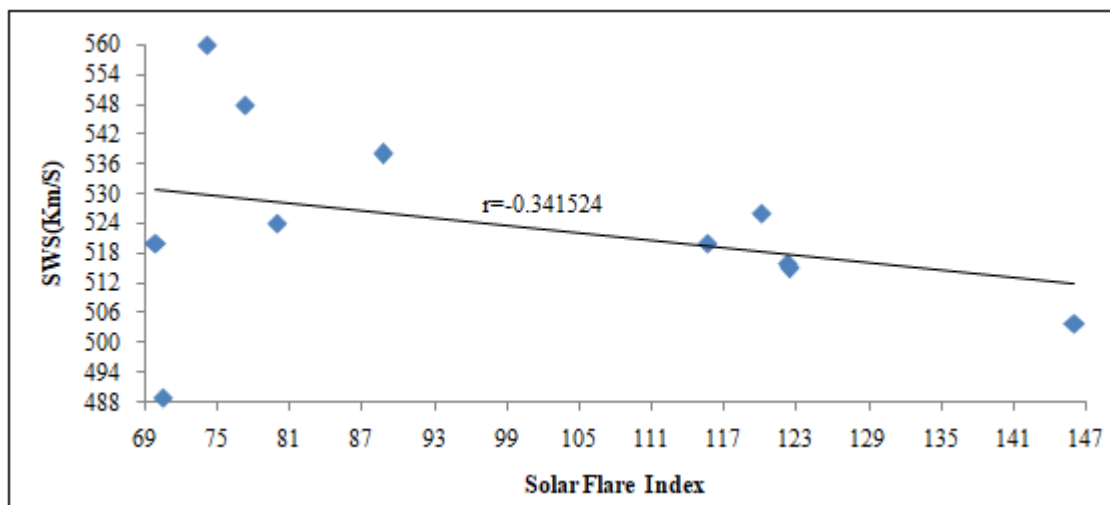


Figure 4: Shows the scatter plot between the yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS) for the period 2008 - 2018. Correlation coefficient is = - 0.34.

#### 4. Conclusion

In this paper we have investigated the correlative study of yearly average value of solar flare index (SFI) with interplanetary magnetic field (IMF) and Solar wind speed (SWS) during the period of 2008 - 2018. We have analyzed correlative study of these selected parameters.

- Positive co - relation has been found between the yearly average value of Solar Flare Index (SFI) and Interplanetary Magnetic Field (IMF). Statistically calculated co - relation co - efficient is 0.71 between these two events.
- Negative co - relation has been found between the yearly average value of Solar Flare Index (SFI) and Solar Wind Speed (SWS). Statistically calculated co - relation co - efficient is - 0.34 between these two events.
- This study provides important information's to the scientific community for the study space weather phenomenon.

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