On Association of Solar Flares with Forbush Decrease

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Abstract. **Solar flares are spectacular short lived phenomenon of the sun marked by high concentrated explosive release of energy. The galactic cosmic rays are significantly affected by such release and produce sudden decrease in the intensity called forbush decrease. Present studies incorporate major flares with $opticalimportance \geq 1$ and associate them with forbush decrease events. Only those flares are considered which occurred three day prior to the onset of the forbush decrease for the period 2000 to 2008. It has been observed that the north south and east west asymmetries of solar flares increases with flare importance and forbush decrease depend upon the importance of pattern flares in general.**

***Keywords*: forbush decrease Solar flares asymmetry**

I. INTRODUCTION

Solar flare is the major outburst of solar activity with release of vast amount of matter and radiation in a short time. They are observed as localized sudden brightening near sunspots. The sun also produces cosmic radiations of low energy associated with certain energetic solar flares which can be detected by ground based detectors. When cosmic rays hit earths upper atmosphere they produce a shower of secondary particles that can reach the ground. Contrary to intuition the cosmic ray doses dropped when solar activity was high. This phenomenon of transient and rapid forbush decrease in cosmic rays intensity followed by a slow recovery typically lasting for several says is forbush decrease. And was discovered by forbush in 1938. Soon after the discovery such decrease in cosmic ray intensity many investigators are searching for the cause of these decrease and their possible association with solar flares.

IUCCI et al 1977 found that the forbush decrease in cosmicray intensity are produced by solar flares associated with type IV burst. Past studies revealed the significance of heliolongitudinat postion of solar flares which are more geoeffective (Grade et al 1983) Shrivastava 2001 and shrivastava and singh 2002 have reported that the association of B type solar flares with coronal mass ejection might be one of the major causes for producing forbush decrease. Shah et al 2003 presented experimental evidence of a major forbush decrease as a result of the extremely high activity of the sun. In a recent paper 2005 the main cause of forbush effect was reported due to depletion in the cosmic rays possibly resulting in a forbush decrease. In the present work we study major flares and associate them with forbush decrease events. We have also observed the flare distribution pattern and calculated north south and east west asymmetry for the same period i.e. 2000-2008, declining phase of cycle 23.

II. METHODOLOGY

For the present study major solar flares as categorized in solar geophysical prompt report for the interval 2000 to 2008 are chosen. All the major flares with $opticalimportance \geq 1$ and associated with forbush decrease events are noted. The major solar flares occurring three day prior to the onset of forbush decrease are considered for the present study. We have identified 127 solar flare with $opticalimportance \geq 1$ and associated with forbush decrease. The data used in the present study have been collected from the H? flare list published in the solar geophysical data during 2000-2008 covering 8 years of solar cycle 23. The north south and east west asymmetry of solar activity phenomenon during 2000-2008 has been calculated. A pattern of frequency of occurrence of solar flares ?1 and associated with forbush decrease for heliolatitudinal and heliolongitudinal zones is also observed.

III. RESULT AND DISCUSSION

Major solar flare having $opticalimportance \geq 1$ and associated with forbush decrease are identified. The east west and north south distribution of solar flare with different optical importance is shown in Table 1.

According to the Table 1 it is clear that flare distribution pattern is almost the same in both hemisphere for flare importance 1, 2 and larger number of flare are observed in eastern and southern zones. Flares having $opticalimportance > 2B$ play a major role in producing forbush decrease. Total 127 solar flares with $opticalimportance > 1$ and associated with forbush decrease are identified. The north south and east west asymmetries are also derived as shown in Table 1. In both the cases i.e. north south and east west asymmetries increases with flare importance. However larger numbers of flares are observed in southern and eastern zones. The heliolatitudinal and heliolongitudinal frequency distribution of $solarflares \geq 1$ and associated with forbush decrease is shown in fig 1. and fig 2.

TABLE I: East west and North South distribution of solar flares for the period 2000 to 2008.

Solar flare	East	West	A=2(E-W)/E+W	North	South	A=2(N-S)/N+S
Imp=1	29	48	-0.49	35	42	0.18
Imp=2	19	16	0.17	15	20	0.29
Imp=3	7	4	0.55	3	8	0.91
Imp¿2B	20	12	0.50	12	20	0.25

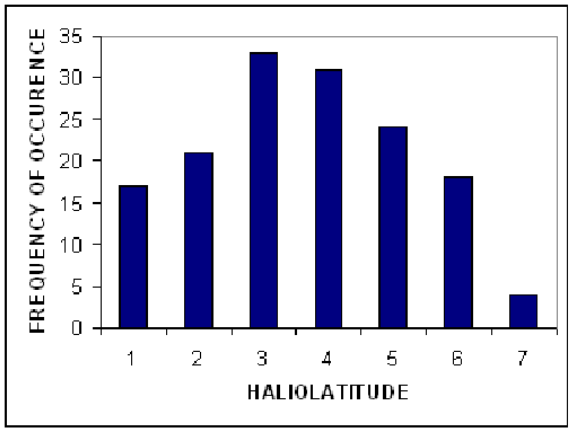

Fig. 1: Histogram of the frequency of ocuerence of $solarflares \geq 1$ associated with Fds for different Heliolatitude zones.

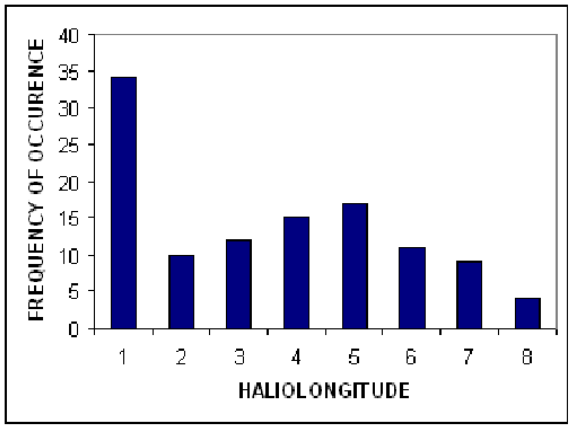

Fig. 2: Histogram of the frequency of ocuerence of $solarflares \geq 1$ associated with Fds for different Heliolongitude zones.

It is observed that in general, magnitude of cosmic ray forbush decrease depend upon the flare importance. The average magnitude of forbush decrease is maximum for the $importanceof > 2B$ Solar flares. This is due to field and plasma which generate shock wave some where between sun and earth. The importance of solar flare play major role in size and strength of these shocks. The unequal distribution of various aspect of solar activity between north and south hemisphere of the sun is well known over a century. The asymmetrical distribution is periodic and indeed related to 11 year sunspot cycle .Verma(1992) predicted that the N-S asymmetry in solar cycle 22,23,24 may be southern dominated, which backs our findings. Hey J.S. Hughes concluded that the asymmetry in the distribution, with greater radio burst emission from flares ,east of central meridian appears to be a general flare characteristic which may be attributed to absorption and refraction in the solar atmosphere above the flare. The asymmetry is emphasized in flare regions associated with the occurrence of high geomagnetic activity. It is suggested that an asymmetry in the distribution of number of flares is similarly attributed to H? absorption in an asymmetrical structure of the solar atmosphere above the flare. The asymmetrical distribution of solar flares generate E-W, N-S asymmetry for forbush decrease. Flares having higher optical importance have more pronounced asymmetries.

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