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Relationship between geomagnetic storms and CRI during the rise and fall of 22 and 24 solar cycles

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Abstract
In this study, we examine the relationship between black geomagnetic storms, CRI and Ap index at rising and falling levels. Our analysis includes the study of sun 22 and 24. We use the stacked period technique to establish a relationship between these parameters. During the analysis of two solar panels, we found a very good result where good Dst value in both phases leads to a good CRI value. Similarly, we compared the Ap index with the Dst and CRI model and found that the smallest peaks of Dst and CRI coincided with the largest peak of the Ap index.

Keywords: Geomagnetic storms, cosmic ray intensity, Ap index, Dst

Introduction
A geomagnetic storm (GS) is the main disturbance of the Earth's magnetic field, caused by the combination of plasma particles emitted by the Sun and the magnetosphere. These are phenomena where the strength of the Earth's magnetic field fluctuates in the order of tens to hundreds of nT. These effects cause various geomagnetic activities. Different researchers have examined the strengths, weaknesses, strengths and performance of GS (Tsurutani *et al*., 1988; Oh and Yi, 2004) [4-5]. Previous studies by many scientists have shown that GS formation is associated with coronal mass ejection (CME), co-rotating interaction region (CIR), solar wind speed, and cosmic ray intensity. Therefore, we cannot say that a single limitation is responsible for GS production.

Materials and Methods
In order to establish the association between Dst index, Ap index and CRI we have adopted a technique of Chree analysis by the superposed epoch method. The occurrence day of geomagnetic storms (criteria Dst ≤-50nT) is considered as zero epoch day. The daily mean values are taken from the omniweb data center (omniweb.gsfc.nasa.gov/form/dx1.html) for the studied period of solar cycle 22 and 24. Now, by considering Dst ≤- 50nT as the zero epoch we have averaged out all the observations in order to plot the graph between these parameters.

Results and Discussion
CRI variation with Dst index and Ap index

Table 1: Correlation coefficients between various parameters

Parameters	Solar Cycle-22 (Ascending)	Solar cycle-22 (Descending)	Solar cycle −24 (Ascending)	Solar cycle −24 (Descending)
Dst and CRI	-0.5	-0.7	-0.6	-0.7
Dst and Ap index	-0.7	-0.8	-0.6	-0.9
CRI and Ap index	-0.6	-0.7	-0.6	-0.7

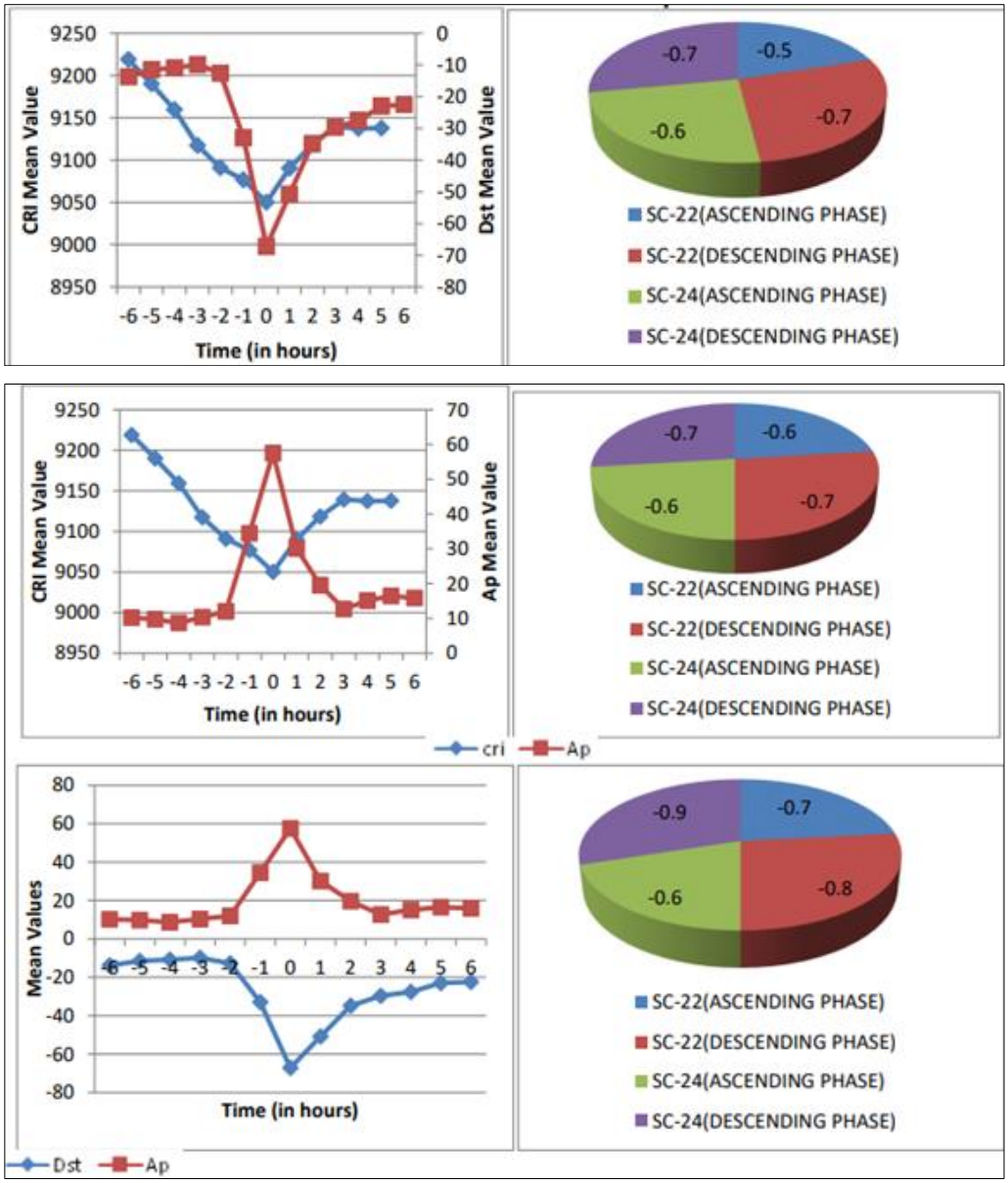

Fig 1a-1c: The result of Chree analysis from -6 day to +6 days with respect to the occurrence day of GS (zero epoch day). In order to study the pattern of Dst with CRI and Ap index the variation of their mean values is plotted for solar cycle 22 and 24.

Figures (1a-1c) show the difference of Dst with CRI and Ap indices during the 22nd and 24th solar cycles. In each solar cycle, we check that on the day GS occurs (day 0) the CRI also exhibits the strongest attenuation. The minimum value of Dst coincides with the largest peak of the Ap index. Further investigation found that CRI was negatively correlated with the Ap index, that is, Ap was highest on the day the CRI occurred. In addition, the correlation coefficients between these two measurements are slightly different for each solar study, but high and positive (Table 1), clearly demonstrating previous findings (Eselevich and Fainshtein, 1993; Gonzalez and Echer, 2005; Kumar and Raizada, 2008) [1-3]. It is clear from Table 1 that the descent phase shows a better correlation compared to the rise phase; this clearly shows that the descending phase has more activity than the ascending phase.

Conclusion

The smallest peak of Dst coincides with the largest peak of the Ap index. For both solar systems, the CRI shows its maximum on the day Dst. The smallest peak of the CRI coincides with the largest peak of the Ap index. Compared to the descending phase, the correlation coefficients of the Dst, CRI, and Ap performance index for the ascending phase are higher and negative, indicating that the descending phase plays an important role in the outcome of solar activity.

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