

STATISTICAL COMPARISON OF THE OCCURRENCES OF GEOMAGNETIC STORMS DURING THE RISING PHASES OF SOLAR CYCLES 21-24.

Ojo, S.O and Akala A.O

ABSTRACT

The minimum following solar cycle 23 was the deepest and longest and geomagnetic activity was at the lowest levels since the dawn of the space era. In this study, the occurrences of geomagnetic storms during the rising phases of solar cycle 21 – 24 are being compared using Dst index, interplanetary magnetic field, sunspot number and solar wind plasma conditions, and the interplanetary coronal mass ejections (ICMEs).

The data obtained from SPIDR, SIDC and OMNI Database were statistically analysed. For the plots, minor and moderate storms were represented with bars coloured yellow and green, while strong and severe storms with bars coloured black and red. Geomagnetic activity continued to be at particularly low levels during the rise phase of cycle 24 compared to similar intervals in cycle 21 through 23. The sunspot number decreases progressively from solar cycle 21 to cycle 24. Except for solar cycle 22, there is a corresponding progressive decrease in the frequency of occurrences of geomagnetic storms from cycle 22 to cycle 24 with the decreasing value of sunspot number.

It is concluded that weak Dst activity during the rising phase of solar cycle 24 was primarily a consequence of weak Bs and the lack of strong and long duration ICMEs. The ICMEs make more significant contribution to the G1 (minor) storm than the G2 (moderate) storms in all the four cycles and the high speed streams of the solar wind contribute also more to G1 than the G2 storms.

The most outstanding feature is the continuing low levels of geomagnetic activity in solar cycle 24 well below those observed during the rising phases of the other cycles studied. Even 4 years into cycle 24, geomagnetic storm rates are still only comparable to or below the rates observed during the minima of other cycles.

The lack of strong southward magnetic fields in ICMEs, and their sheaths, the lower speeds and weaker fields in corotating high speed streams, contribute to the low level of geomagnetic storm activity in the rise phase of cycle 24. This result will support future research work for space weather, deeper understanding of the causes, effects and protection against the hazards of geomagnetic storms.