GEOMAGNETIC STORM OCCURRENCE AND THEIR RELATION WITH SOLAR CYCLE PHASES

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Abstract:

Using a time series of geomagnetic storm events between 1957 and 2019, obtained by selecting storms where Dst < -50 nT, we have analyzed the probability of occurrence of moderate, intense and severe events. Considering that geomagnetic storms can be modeled as stochastic processes with a log-normal probability distribution over their minimum Dst index, the dataset was separated according to solar cycle and solar cycle phases, and the distributions of events were fitted through maximum likelihood method in order to characterize the occurrence of storms in each cycle and phase, and then compare those occurrences to the solar cycle 24 (SC24). Our results show that there is a strong dependence between the occurrence of intense storms, with Dst < -100 nT, and the strength of the solar cycle measured by the sunspot numbers. In particular, SC24 is very similar to SC20. However, when comparing the occurrence of storms by solar cycle phases, events tend to show similar activity towards the minimum phase and have significant differences in the maximum phases. By looking at the σ value -- the fit log-normal distribution "width" parameter -- characteristic of the occurrence rate of storms, we have found that the σ_{des} (the sigma value in the descending phase of one cycle) shows the highest correlation r=-0.76 with σ_{max} (the sigma value in the maximum phase of the next cycle) which allows us to estimate the occurrence rate of storms for SC25 to be similar to those of SC21 and SC22, suggesting a more intense cycle than the one that just ended.

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References:

[1] Reyes, P. I., Pinto, V. A., & Moya, P. S., Geomagnetic storm occurrence and their relation with solar cycle phases. Space Weather, 19, e2021SW002766 (2021).

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