

Estimation of the extreme geomagnetic storm level by utilizing extreme value statistics

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Extreme GIC events, hazardous to some technological systems in our current society, must be associated closely with a large disturbance in the geomagnetic field. The typical prominent phenomenon is the geomagnetic storm, which is defined by the time variation of the Dst-index. The interest of the present study is the statistical assessment of the occurrence of severe storms, characterized by the large negative depression of Dst less than -100 nT. The largest storm in the recorded history is known as the Carrington event of 1859, whose Dst was estimated to be -1750 nT. In the published Dst since 1957, the largest value is -589 nT on March 1989. Using the whole Dst database is inadequate for drawing the precise statistics of the occurrence of such "superstorms" due to its rareness. In the present study, we utilize extreme value statistics, which focuses on the statistical behavior only in the tail of the distribution. We extract the Dst data less than -280 nT and determine the form of the generalized Pareto distribution by fitting this subset to it. This enables us to estimate the imaginable largest storm level, as well as the occurrence probability for the specific level in several decades ~ centurial scale.