



Statistical study of strong and extreme geomagnetic disturbances and solar cycle characteristics

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Extreme space weather storms are low-probability, but high-consequence events that may have a significant impact on the modern technological infrastructure in space and on ground. We present here the results on the correlation analysis between the occurrence of extreme geomagnetic storms and solar cycle characteristics using an extensive geomagnetic index AA data set spanning over 150 years (13 solar cycles) complemented by the Kakioka magnetometer recordings. Our results show that the correlation between the storm occurrence and the strength of solar cycle decreases from a clear positive correlation with increasing storm magnitude towards a negligible relationship. Hence, also the calmer Sun can launch super-storms. Examples of such events are the Carrington storm in 1859 and the July 2012 CME that impacted the STEREO-A spacecraft, both of which occurred during relatively weak solar cycles. Our results further suggest that while weaker storms occur most frequently in the declining phase the most extreme storms have a tendency to occur near solar maximum. We also discuss the implications of our findings for the connection between the extreme solar eruptions and multi-scale solar dynamo generated magnetic fields.