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Development of intense magnetic storms

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During magnetic storms the complex system of the Earth's magnetosphere, which corresponds to an open spatially extended nonequilibrium (input - output) system, manifests itself in linkages between space and time, producing characteristic fractal structures. The fractal spectral properties of the geomagnetic activity indices (e.g., k_p, D_{st}), as well as time series of the Earth's magnetic field, recorded in observatories around the globe, covering a period of two solar cycles, are examined using wavelet analysis methods. A way to examine transient phenomena is to divide the measurements into time windows and analyze these windows. If this analysis yields different results for some precursory time intervals, then a transient behavior can be extracted. We find that the underlying complexity manifests itself in linkages between space and time, generally producing fractal patterns, as the final global instability is approached. We show that distinctive alterations in the associated scaling parameters of these geomagnetic time series emerge when an intense magnetic storm approaches. Whether the development of this extreme event can be studied in the context of the theory of self-organized or intermittent criticality will be discussed.