A statistical of geomagnetic disturbances: storm-substorm relationship

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The magnetosphere is a nonlinear system, in which energy from the solar wind is being transformed into energy in the ionosphere and the inner magnetosphere. Recently, a number of papers have reported that there are various phenomena showing the power-law dependence of their probability distributions against the magnitude of the disturbances. This scale-free (the power-law) property can be considered as a consequence for a system being driven in a state of self-organized criticality (SOC). The SOC system evolves naturally into a critical state with no characteristic length or time scale.

In this presentation, we report the results of a statistical study of the long-term geomagnetic indices (AL, AU, ASY-H, and SYM-H). It is found that the parameters characterizing the probability distribution show obvious power law forms suggesting that SOC system plays impotant role in solar wind - magnetisphere interaction. Using solar wind parameters, probability distributions of solar wind events are derived. The distributions have, similar to those of the geomagnetic indices, power-law forms with exponential decay. Comparing the probability distributions of geomagnetic indices with those of solar wind parameters, the relationship between geomagnetic storms and substorms is discussed.