AOGS 2006

Quantification of a Long-Term Geomagnetic Storm Occurrence

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We propose the idea of quantitating a long-term prediction of geomagnetic storms, which deduces probabilities of the occurrence intensity and frequency from the 45-year (1957-2001) database of Dst-index. The former probability estimates the storm level which can take place once every T-year scale (T-year return level): The distribution of the whole Dst shows a power-law tail (index -4.96) under -280 nT, so that the generalized Pareto distribution (GPD) can be fitted to this subset with Dst $<$ -280 nT data. GPD leads to predict the T-year return level. For instance, 10-year return level is Dst = -450.8 nT. The latter probability (storm frequency) is evaluated by assuming the storm occurrence as a time-varying Poisson process: We pick up the 321 intense and independent storm events, which satisfy Dst $<$ -100 nT and the interval of occurrence $>$ 48 hours. The occurrence rate is found to vary with the solar cycle; the rate per 13 weeks approximates to 0.67 in the weak phase, and 2.62 in the active phase. These rates further derive the occurrence probability by applying a Poisson distribution.