# The waiting-time distribution of geomagnetic storm occurrences

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We evaluate the occurrence frequency of intense geomagnetic storms quantitatively by analyzing the statistical properties of its waiting-time, the time interval between one storm to the next. Total 321 storm events are picked up from the 45-year (1957-2001) database of Dst-index, where the peak Dst-index is less than -100nT and the waiting-time is more than 48 hours. The waiting-time distribution (WTD) exhibits a power-law tail over 1000 hours, about one and a half months. The index is -2.2, which is almost consistent with the case of X-ray solar flares greater than C-class (Wheatland and Litvinenko, 2002). Such a distribution can be described by a time-dependent Poisson process. The purpose of this study is to determine the Poisson parameter, which is equivalent to the average occurrence rate per a unit period. Here, we take three months as a unit. Since the parameter strongly depends on the solar cycle, we compare the average rate with the sunspot number. A clear difference can be identified in the average rate at the monthly-averaged sunspot number more or less than 40, where we divide the solar cycle (cycle 20-23) into active and quiet periods. The WTD for each period also exhibits the power-law tail; the index is -2.2 (-1.4) for the active (quiet) period, respectively. We further determine the average occurrence rate per three months by 2.3 (0.7) for the active (quiet) period. Results of a chi-square goodness-of-fit test show that our null hypothesis, the storm occurrence is a solar-cycle dependent Poisson process, can not be rejected on average for both active and quiet period under a 5% significance level. The resultant Poisson distribution will estimate the probability of an expected occurrence frequency in future, which can be in practical use for a long-term space weather forecast as a quantitative management of a risk in space activity.