Evaluation of the probability forecast on geomagnetic storm occurrences

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The practical application of space weather research is to establish the occurrence prediction of solar-terrestrial phenomena, especially hazardous to the Earth-space environment. In this study, special attention is paid to an intense geomagnetic storm (peak Dst less than -100 nT), one of the most important event for space weather. Total 322 events are obtained between 1957 and 2001. We focus on a long-term (monthly to yearly scale) forecast, which gives a probability of storm occurrences in a specific period rather than a prediction of any physical quantities in real time. The ordinary chi-square tests of goodness of fit can not reject the hypothesis that the time interval of such storm occurrences is governed by a solar cycle-dependent Poisson process, where the mean occurrence rate (per three months) is 2.3 for the solar active phase and 0.7 for the quiet phase. Therefore, by regarding the occurrence frequency as a Poisson distribution, a future probability is forecasted according to the solar cycle. To verify the performance by comparing the forecast and observed probabilities, the Brier score (BS) is computed. The smaller BS signifies a better quality forecast. We will further report how to build an accurate forecast (making BS small) by introducing several models which exhibit piecewise variations in the occurrence rate.