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ORIGINAL ARTICLE

Solar cycle distribution of great geomagnetic storms

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Abstract The distribution properties of great geomagnetic storms (Dst ≤ -200 nT) and super geomagnetic storms (Dst ≤ -300 nT) across the solar cycles (19–23) are investigated. The results show that 73.2% of the great geomagnetic storms took place in the descending phase of the solar cycles. 72.7% of super geomagnetic storms occurred in the descending phase of the solar cycles. About 83% of the great geomagnetic storms appeared during the period from the two years before solar cycle peak and the three years after solar cycle peak time. 90.9% of the super geomagnetic storms appeared between the two years before solar cycle peak and the three years after solar cycle peak. When a solar cycle is very strong, the phenomenon that great geomagnetic storms concentrated during the period from the two years before the solar cycle peak time to the three years after the solar cycle peak time is very prominent. The launch time of space science satellite is suggested according to the distribution properties of great geomagnetic storms and super geomagnetic storms in solar cycles.

Keywords Solar activity · Great geomagnetic storms · Sun-earth connection

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1 Introduction

Intense geomagnetic storms (Dst ≤ -100 nT) can be induced by interplanetary coronal mass ejections (ICMEs) or a corotating interaction region (CIR) (Gosling et al. 1991; Tsurutani and Gonzalez 1997; Richardson et al. 2002; Zhang et al. 2007 and reference therein). Gonzalez et al. (1990) studied the dual-peak solar cycle distribution of intense geomagnetic storms (Dst ≤ -100 nT) occurred during 1965–1985. The result of their paper provided evidence that the distribution of intense geomagnetic storms occurred during a solar cycle has a two peak with one peak occurring at the late ascending phase of the solar cycle or at solar maximum and another at the early descending phase of the solar cycle. The data collected during the period of 1965–1985 (Gonzalez et al. 1990) are not long enough to generate the results that are statistically meaningful. In order to see if the dual-peak distribution of intense geomagnetic storms has the similar distribution, they chose aa index (Mayaud 1980) as a suitable indicator of the geomagnetic activity and investigated the solar cycle distribution of intense geomagnetic storms with aa index >100 nT occurred during solar cycles (12–19). However, aa index is not Dst index. The solar source of an intense geomagnetic storm can be a coronal hole or a coronal mass ejection (CME).

A great geomagnetic storm (Dst ≤ -200 nT) is a major Sun-Earth connection event during which the disturbance