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Occurrence characteristics of relativistic electron microbursts in association with storms and substorms

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Relativistic electron microbursts (REMBs) are short-lived (<1sec), bursty precipitations of relativistic (>1 MeV) electrons observed in the outer radiation belt. REMBs are first reported by the SAMPEX measurements [Nakamura et al., 1995; Blake et al., 1996] and preferentially observed on the dawn side magnetosphere during geomagnetic storms [Nakamura et al., 2000; Lorentzen et al., 2001]. Pitch angle scattering of relativistic electrons by discrete whistler mode wave emissions (chorus) has been considered as the primary candidate for REMBs [e.g., Lorentzen et al., 2001]. Chorus emissions can resonate with not only MeV electrons but also electrons with energies from several to tens keV, leading to diffuse and pulsating auroras [Thorne et al., 2010; Nishimura et al., 2010, Miyoshi et al., 2010]. Since diffuse and pulsating auroras are commonly observed during the recovery phase of substorms, it is expected that occurrence of REMBs depends on the substorm activity. To test the hypothesis, we have investigated occurrence characteristics of REMBs in association with the substorm activity using the data obtained from the SAMPEX spacecraft. Since REMBs are frequently observed during geomagnetic storms, we have also investigated differences of the occurrence characteristics between storm time and non-storm time substorms. We have derived occurrence rates of REMBs in L-value versus magnetic local time domain. AE$*$, which is the maximum value of the AE index in previous 3 hours, is used to represent the substorm activity levels. We have defined storm time and non-storm time by using the minimum value of the SYM-H index in previous 2 days. We found that REMBs are most frequently observed during strong substorm activities. The occurrence rates of REMBs do not depend on the levels of substorm activities, although chorus wave intensity increases as the AE$*$level increases [e.g., Li et al., 2009]. Comparison of the occurrence rates during storm time and non-storm time substorms for same AE$*$levels indicates that REMBs are preferentially observed during storm time substorms. Thus, it is concluded that REMBs most frequently occur during strong substorm activities associated with storms. We will discuss suitable magnetospheric conditions leading to the REMB occurrence considering the configuration of the inner magnetosphere during storm time substorms.

Keywords: relativistic electron microbursts, chorus, SAMPEX, storm, substorm, diffuse aurora