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Estimation of the radial diffusion coefficient using REE-associated ground Pc 5 pulsations

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Pc 5 pulsations with frequencies between 1.67 and 6.67 mHz are believed to contribute to the REE in the outer radiation belt during magnetic storms, by means of the observations [Baker et al., 199 8; Rostoker et al., 1998; Mathie and Mann, 2000; O'Brien et al., 2001, 2003] and several theoretical studies. The latter studies are roughly categorized into two themes: in-situ acceleration at L lower than 6.6 by wave-particle interactions [Liu et al., 1999; Summers et al., 1999; Summers and Ma, 2000] and acceleration by radial diffusion from the outer to the inner magnetosphere [Elkington et al., 1999, 2003; Hudson et al., 2000; Kim et al., 2001]. One possible acceleration mechanism is the resonant interaction with Pc 5 toroidal and poloidal pulsations, referred as the radial diffusion mechanism. One of unsolved problems is where and which Pc 5 pulsation mode (toroidal and/or poloidal) play effective role in the radial diffusion process. In order to verify Pc 5 pulsation as the major roles for REEs, we have to examine the time variation of electron phase space density (cf. Green et al., 2004). Electron phase space density is not directly measured, but we can estimate radial diffusion coefficients which determine the electron transportation efficiency, using ground-based magnetic field data.

We estimated the radial diffusion coefficient of ground Pc 5 pulsations associated with the Relativistic Electron Enhancement (REE) in the geosynchronous orbit. In order to estimate the radial diffusion coefficient D_{LL}, we need the value of in-situ Pc 5 electric field power spectral density. In this paper, however, we estimated the equatorial electric field mapped from Pc 5 pulsations power spectral density on the ground. Reciprocal of radial diffusion coefficient describes the timescale $T_{LL}$for an electron to diffuse 1 R_E. Applying a superposed epoch analysis to timescales $T_{LL}$of the radial diffsuion for 12 REE events in 2008, we found that when the relativistic electron enhancements occur, T_{LL}at higher latitude (L larger than 5) is predominantly diffusional, whereas T_{LL}at lower latitude (L less than 4) is mainly convectional.

We concluded that higher-latitude Pc 5 pulsations play more effective roles than lower latitude Pc 5 pulsations in the radial diffusion proscess.