A study of radial diffusion coefficients using in radial diffusion model

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A lot of research of a flux variation of radiation belts with geomagnetic activity have been carried out. However, the mechanism of the variation has not been understood in quantitative aspects.

A radial diffusion model can reproduce a basic structure of the radiation belts [Lyons and Thorne, 1973]. Radiation belt particles are supplied from plasmasheet, and the flux is arranged by the balance of intensity of the diffusion and the loss due to pitch-angle scattering.

The radial diffusion is caused by breaking invariance of particles' third adiabatic invariant due to perturbations of electromagnetic wave in the magnetosphere [Falthammer, 1965]. Origin of such electromagnetic perturbations are considered an effect that sudden compression of the geomagnetic field by solar wind, convection electric field pulses [Cornwall, 1968; Chen et al, 1992; Chen et al, 1993] and Pc-5 ULF wave [Elkington et al, 1999; 2003] during magnetic storms, but it is not known in detail.

In some studies, time-independent radial diffusion coefficients are used [Beutier and Boscher, 1995; Beutier et al, 1995; Fok et al, 2001; Zheng et al, 2003], while in others, radial diffusion coefficients which depend on K_p [Brautigam and Albert, 2000; Miyoshi et al, 2003] or solar wind parameters [Li et al, 2001] are used.

Brautigam and Albert [2000] derived electric field variation as linear function of K_p from the observed value. Applying it to electrostatic diffusion coefficient derived by Cornwall [1968] and doing radial diffusion simulation, the flux distribution and variation in the outer belt are reproduced roughly but the slot region is not formed and the flux near Earth region is too large. This indicates that this diffusion coefficient is not appropriate near Earth region.

In this study, we will survey of diffusion models in past studies, and shed light on issues in those.