Study on characteristics of drift resonance between outer radiation belt electrons and a monochromatic Pc5 wave based on GEMSIS-RC and RB simulations

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Outer radiation belt relativistic electrons are accelerated in the inner magnetosphere. The acceleration mechanisms are roughly classified as two categories ; Radial transport and Local acceleration. Radial transport of relativistic electrons due to Ultra Low Frequency (ULF) waves in the Pc5 frequency range (1.67mHz - 6.67mHz) is one of important candidates to accelerate the outer radiation belt electrons. The acceleration is considered as a result of the drift resonant process. This process is a resonant mechanism between the electron drift motion in the dipole-dominated magnetic field configuration and the electromagnetic fluctuations of Pc5 waves in the inner magnetosphere. The resonance violates the third adiabatic invariant of electrons, while it conserves the first and second adiabatic invariants. Recent studies have pointed out that the radial transport due to the drift resonance can produce one or more localized peaks in radial profile of the phase space density (PSD) [Degeling et al., 2008]. Ukhorskiy et al. [2008] indicated that collective motion of outer belt electrons can exhibit large deviations from radial diffusion. Since the peak in PSD is considered as an evidence of local acceleration [e.g., Reeves et al., 2013], these studies have raised fundamental questions in the radiation belt electron acceleration. Thus, in this study, we investigated the fundamental characteristics of radial transport due to the drift resonance between a monochromatic poloidal Pc5 wave and relativistic electrons based on two unique models ; GEMSIS-RC and GEMSIS-RB.
GEMSIS-RC model is a self-consistent and kinetic numerical simulation code solving the five-dimensional drift-kinetic equation for the ring-current ions in the inner-magnetosphere coupled with Maxwell equations [Amano et al., 2011]. The GEMSIS-RB code conducts test particle trajectory tracings of relativistic electrons in arbitrary magnetic and electric field configurations [Saito et al., 2010]. We conducted Pc5 wave simulation with GEMSIS-RC, and then the obtained time variations of the magnetic and electric fields are used as inputs to GEMSIS-RB to calculate the electron transport due to the Pc5 wave. In order to investigate fundamental nonlinear behavior of radial transport, we investigated effects of a monochromatic wave on the radial transport. The result shows that resonant interaction has a finite width due to the nonlinear process and electrons with smaller pitch angle (70°) are transported deeper inside to small L region than 90 degrees electrons. It is considered that the amount of time to come into resonant width becomes longer due to the change of pitch angle while the first and second invariant are conserved.

Keywords: Radiation belt electrons, Drift resonance, GEMSIS-RC and RB

