Roles of magnetospheric convection on nonlinear drift resonance between electrons and ULF waves

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In the Earth’s inner magnetosphere, charged particles can be accelerated and transported by ultralow frequency (ULF) waves via drift resonance. We investigate the effects of magnetospheric convection on the nonlinear drift resonance process, which provides an inhomogeneity factor S to externally drive the pendulum equation that describes the particle motion in the ULF wave field. The S factor, defined as the ratio of the driving amplitude to the square of the pendulum trapping frequency, is found to vary with magnetic local time and as a consequence, oscillates quasi-periodically at the particle drift frequency. To better understand the particle behavior governed by the driven pendulum equation, we carry out simulations to obtain the evolution of electron distribution functions in energy and L-shell phase space. We find that resonant electrons can remain trapped by the low-m ULF waves under strong convection electric field, whereas for high-m ULF waves, the electrons trajectories can be significantly modified. More interestingly, the electron drift frequency is close to the nonlinear trapping frequency for intermediate-m ULF waves, which corresponds to chaotic motion of resonant electrons. These findings shed new light on the nature of particle coherent and diffusive transport in the inner magnetosphere.