Effects of convection electric field on nonlinear drift resonance between electrons and Ultralow frequency waves

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We derive nonlinear equations describing drift resonant interaction between relativistic electrons and ultralow frequency waves in the presence of convection electric field based on Li et al. (2018). The equation of motion can be approximately expressed in the form of nonlinear pendulum equations with the external driver (azimuthal inhomogeneity factor S), which is defined as a ratio of driving amplitude to the square of trapping frequency. We compare the dynamics of electrons with different S values at different resonant energies (corresponding to different ULF wave numbers). The trajectories of electrons show an obvious transition from periodic motion to chaotic motion as wave number m becomes larger. We compute trajectories of a large number of electrons with the same initial energy and L shell uniformly distributed around the earth, and follow the evolution of the distribution function in energy and L shell phase space. We find that drift resonant electrons can remain trapped by the low-m ULF waves under the strong convection electric field, while trajectories are significantly modified considering a high-m ULF wave. The simulation results demonstrate that the convection electric field plays a role for the transport of the trapped electrons under high-m ULF waves but rarely affects the trapping motion under low-m ULF waves.