Amplitude dependence of whistler wave motion on electron scattering process

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Whistler mode chorus waves cause scattering and acceleration of energetic electrons in the inner magnetosphere. The interaction processes have been modeled as diffusive process. The pitch angle diffusion coefficients of the pitch angle scattering depend on the power of chorus waves, so that it is expected that the scattering rate also depends on the wave amplitude. On the other hand, several previous studies indicated that the Lorentz force by the wave magnetic field is larger than the mirror force if the wave amplitudes increase and the electron trajectories in the velocity space are different from the diffusive distributions. In this study, we investigate chorus wave amplitude dependence of electron scattering using the GEMSIS-RBW simulation code. The RBW simulation demonstrates generation of periodical rising-tone chorus waves propagating along a magnetic field line to higher latitudes, and calculates local pitch angle and energy change by the imposed waves on the field line. At small wave amplitudes, time variations of pitch angle and energy of electrons are similar to diffusive process. At large wave amplitudes, some electrons increase both pitch angle and energy at interaction with the first rising tone, and then they decrease these parameters at interaction with the second rising tone. The process in the first rising tone seems to be the phase trapping, while the process in the second rising tone seems to be dislocation. Therefore, nonlinear scattering processes, which are phase trapping and dislocations, occur during the interactions with periodical rising-tone chorus waves with large amplitudes, which are quite different from quasi-linear scattering process.

