Numerical simulation on energetic electron precipitations by chorus waves

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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 a diffusive process. The pitch angle diffusion coefficients of the pitch angle scattering depend on the power of chorus waves so 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 the chorus wave amplitude dependence of electron scattering using the GEMSIS-RBW simulation code. The RBW simulation demonstrates the generation of periodical rising-tone chorus waves propagating along a magnetic field line to higher latitudes and local pitch angle scattering by the imposed waves on the field line.
As the wave amplitude increases, the pitch angle of the electrons is scattered by the non-resonant interaction due to the influence of the wave magnetic field. We discriminate of resonant and non-resonant electron population, and investigate the amplitude dependence of precipitating electron counts for two populations. A positive correlation was found between the wave intensity and precipitating counts of resonant electron when the wave amplitudes are smaller than 10^-4 of the ambient magnetic fields.. When the wave intensity becomes large, precipitating counts of resonant electrons decrease. The parameter ρ (e.g., Saito et al., 2016) has used as a proxy to discriminate different interaction processes among diffusion, phase trapping and dislocation. Note that a positive correlation between the wave intensity and precipitating counts of resonant electrons are violated despite of small ρ (<1), i.e., diffusive interactions. Simultaneously, precipitating counts of non-resonant electrons increases, indicating that non-resonant interactions contribute to precipitation of electrons.

