Numerical study of chorus wave generation in the inner magnetosphere during the storm-time condition

Yuto Katoh[1]; Yoshiharu Omura[2]; Yoshizumi Miyoshi[3]; Mitsuru Hikishima[4]; Kanako Seki[3]
[1] Dept. Geophys., Grad. Sch. Sci., Tohoku Univ.; [2] RISH, Kyoto Univ.; [3] STEL, Nagoya Univ.; [4] Grad. Sch. Sci., Tohoku Univ.

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We study the generation process of whistler-mode chorus emissions in the inner magnetosphere during geomagnetic storms based on the simulation results of whistler-mode chorus generation by PIC codes [Katoh and Omura, GRL 2007; Hikishima et al., JGR 2009] and a global magnetospheric model using Ring current-Atmosphere interactions Model (RAM) [Jordanova and Miyoshi, GRL 2005; Miyoshi et al., JGR 2006].

In the Earth's inner magnetosphere, whistler-mode chorus emissions are observed mostly on the dawn side and are enhanced during geomagnetically disturbed periods. Chorus emissions are generated through the nonlinear wave-particle interactions with energetic electrons of tens of keV having a velocity distribution function with a temperature anisotropy, while these anisotropic electrons are transported from the nightside plasma sheet by the injection and/or enhanced convection during substorms.

The generation process of rising tone chorus emissions has been studied by PIC simulations and properties of chorus generation have been investigated by changing the initial condition of number density of energetic electrons and amplitude of seed waves assumed in the simulations. Recent studies revealed that frequency sweep rates of rising tone chorus emissions are determined by the wave amplitude of chorus elements and that there exists a threshold of wave amplitude in triggering rising tone emissions [Katoh and Omura, JGR 2011; Hikishima and Omura, JGR 2012].

In the present study, by referring the results of both PIC simulations and global model, we discuss the location and timing of chorus wave generation in the inner magnetosphere during the storm-time condition. By the global model, we study the spatial distribution of positive linear growth rates of whistler-mode waves in the inner magnetosphere and its time evolution quantitatively. We also investigate the realistic spatial inhomogeneity around the magnetic equator by the Tsyganenko magnetic field model at the location of the positive linear growth rate. We discuss whether nonlinear wave-particle interactions take place or not by referring the result of PIC simulations in the region where the whistler mode waves are efficiently enhanced in the global model. The results of the present study serve important clues in understanding where and when chorus emissions are generated in the storm-time inner magnetosphere and would contribute to the ERG mission measuring energization of radiation belt electrons.