Study of ULF waves and its effect on radial transport of relativistic electrons based on MHD-Ring current model coupling

Kei Kamiya[1]; Kanako Seki[2]; Shinji Saito[3]; Takanobu Amano[4]; Yoshizumi Miyoshi[5]
[1] none; [2] Dept. Earth & Planetary Sci., Science, Univ. Tokyo; [3] Nagoya Univ.; [4] University of Tokyo; [5] ISEE, Nagoya Univ.

Pc5 Ultra-Low Frequency (ULF) waves in the inner magnetosphere are observed as electromagnetic fluctuations with frequencies of 1.67-6.67 mHz and considered as a driver of the radial transport of relativistic electrons in the outer radiation belt. We recently showed that electron interactions with a continuous monochromatic Pc5 wave can produce butterfly pitch angle distributions in the outer radiation belt [Kamiya et al., JGR, 2018]. The mechanism depends on the latitudinal profile of the wave power and spectrum of the Pc5 waves. In order to model more realistic spatial distributions and spectra of ULF waves, we need to improve the outer boundary setup of the global ring current simulation.

In this study, we have developed a one-way model coupling method between two models, i.e., Global MHD-based simulation of the magnetosphere, BATS-R-US+CIMI, and a 5-D drift-kinetic ring current simulation, GEMSIS-RC. The BATS-R-US+CIMI solves the ideal MHD equations for the regions from the sunward boundary to the inner magnetosphere including the ring current pressure gradient. The GEMSIS-RC describes the distribution function of ring current ion together with time evolutions of the electric and magnetic fields self-consistently, which include the ULF waves in the inner magnetosphere. We developed a method to adopt the time-dependent outer boundary condition for GEMSIS-RC based on ion density, temperature, bulk velocity, and magnetic field obtained from BATS-R-US+CIMI simulation to solve the propagation of ULF waves in the inner magnetosphere. The results show that the fast mode waves imposed at the outer boundary propagates in GEMSIS-RC simulation domain as expected from the theoretical fast mode speed. The mode conversion from fast mode to shear Alfven wave along the field line are also seen as the wave propagates inward. We discuss the validity of the model coupling method and the ULF wave interactions with radiation belt electrons using a guiding center test particle simulation: GEMSIS-RB.