# Relative contribution of ULF and chorus waves to the radiation belt variation: Comparison between multi-point observations and BATSRUS + CRCM simulation

*Naoko Takahashi[1], Kanako Seki[1], Mei-Ching Fok[2], Yihua Zheng[2], Yoshizumi Miyoshi[3], David Hartley[4], Ayako Matsuoka[5], Yoshiya Kasahara[6], Yasumasa Kasaba[7], Nana Higashio[8]

1. Graduate School of Science, University of Tokyo, 2. NASA Goddard Space Flight Center, 3. Institute for Space-Earth Environmental Research, Nagoya University, 4. Department of Physics and Astronomy, University of Iowa, 5. Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 6. Information Media Center, Kanazawa University, 7. Planetary Plasma and Atmospheric Research Center, Tohoku University, 8. Japan Aerospace Exploration Agency

Earth’s radiation belt is the area where electrons with energies from hundreds of keV to several MeV are trapped. When, where, and how the radiation belt exhibits a dramatic variation during a magnetic storm is of global interest. The dynamic variation of the radiation belt is caused by various wave-particle interactions: (1) the radial diffusion of electrons driven by ultra-low-frequency (ULF) waves in Pc5 frequency ranges (1.6–6.7 mHz) and (2) the local acceleration caused by wave-particle interactions between whistler-mode chorus waves and radiation belt particles. Over the past decade, multi-point observations and numerical simulations have provided evidence to support above physical processes. However, it is debatable how much each wave contributes to the radiation belt variation during a magnetic storm. A few previous studies have quantitatively compared roles of local acceleration and radial transport by calculating diffusion coefficients, whereas the global context between the wave growth and the relativistic electron flux enhancement has not been extensively studied. To address these issues, the comprehensive study using multi-point observations and numerical simulations (not empirical models) makes essential and significant contributions.

We focus on the magnetic storm on 27-30 May 2017. This magnetic storm is triggered by coronal mass ejections and induces a clear interplanetary shock. Fortunately, several satellites are scattered in the inner magnetosphere and detect both ULF and chorus waves during this magnetic storm. Arase and Van Allen Probes also detect variations of relativistic electron fluxes associated with the Dst index variation. We examine L-value dependence of ULF and chorus wave powers and find the difference of wave activity during the recovery phase. The chorus wave activity is large during the early recovery phase, while the ULF wave activity is large during the late recovery phase. The difference of wave activity may contribute to the radial profile in the phase space density of relativistic electrons. To grasp the extent of individual wave contribution, we also perform the comprehensive ring current model (CRCM) coupled with Block-Adaptive-Tree Solar-Wind Roe-Type Upwind Scheme (BATSRUS) simulation. BATSRUS with CRCM well reproduces global characteristics of energetic electron fluxes and wave growth during this magnetic storm. We will further evaluate global distribution of simulated wave power comparing to the observation, and then discuss the temporal and spatial context between each wave growth and the radiation belt variation.

 