Contribution of ULF and chorus waves to the radiation belt dynamics based on Arase observations and BATSRUS+CRCM simulation

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The Earth’s radiation belt exhibits a dramatic variation, especially during the active condition of the magnetosphere such as magnetic storms. Two candidate mechanisms that are known to cause variations of relativistic electrons include: (1) the radial diffusion of the 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 enable us to discuss the contribution of each wave to the acceleration of relativistic electrons. However, it is debatable how much these waves affect to the global variation of the radiation belt. In addition, it is known that the radiation belt variation depends on the solar wind type, i.e., coronal mass ejections (CME) and co-rotating interaction regions (CIR), but the difference of ULF and chorus wave activities between different solar wind-type storms is still an open issue. In this study, we compare the temporal variation of ULF and chorus wave activities between CME-and CIR-type storms, and then discuss the relationship to the acceleration of relativistic electrons in the radiation belt.

We focus on two CME-type storms (28 May 2017 and 8 September 2017) and two CIR-type storms (27 March 2017 and 27 September 2017). During these storms, Arase satellite observed the enhancement of relativistic electron flux and activities of ULF and chorus waves. To understand the global extent of ULF waves, we calculate the total wave power from Arase-related ground observations. The ULF wave activity on the ground depends on both AE index and solar wind dynamic pressure, which consistent with magnetic field data detected by the Arase satellite. We also investigate the characteristics of ULF and chorus activity in the magnetosphere using both Arase satellite and Van Allen Probes. During CME-type storms, the ULF wave activity is large in the main phase and the end of the recovery phase, while the chorus wave activity is large in the beginning of the recovery phase. On the other hand, during CIR-type storms, both ULF and chorus wave activities are constantly large. In this presentation, we will also show the global distribution of ULF and chorus waves in the magnetosphere based on numerical simulations.