Dynamics of VLF/ULF plasma waves in the inner magnetosphere during CME- and CIR-driven magnetic storms

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Energetic electrons in the outer radiation belt changes with magnetic storms. In relation to the acceleration mechanisms of the energetic electrons, ULF and VLF plasma waves are considered as plausible drivers of acceleration. ULF Pc5 waves are a driver for the betatron acceleration via enhanced radial diffusion, while VLF whistler mode waves are important for the non-adiabatic acceleration via wave-particle interactions. Recent statistical study showed that variations of the outer radiation belt are different between CME- and CIR-driven storms. So, it can be expected that dynamics of ULF/VLF plasma waves are also different between CME- and CIR-driven storms. However, such differences of plasma waves in the inner magnetosphere between CME- and CIR-storms have never been examined. In this study, as a case study, we examined energetic particles, ULF waves observed by the ground-based magnetometers of the CARISMA stations, and VLF waves measured by the Akebono satellite for two magnetic storms; one is a CME-driven storm, and another is a CIR-driven storms. The minimum Dst indices of both storms are almost same, about -110 nT. Relativistic electron fluxes which increased during the recovery phase are different from the two storms; the flux is 1000 PFU in the CME-storm, while that is just 10000 PFU in the CIR-storm. ULF Pc5 waves and whistler mode waves are also different between two storms. During the CME-storm, both ULF Pc5 and whistler mode waves enhance only during the main phase, and their activities decrease during the recovery phase. On the other hand, intense ULF Pc5 and whistler mode waves are observed from the main phase to the recovery phase. The power of ULF Pc5 at L=4 during the main phase of the CME-storm is larger than the CIR-storm. Thus, it is suggested that differences of both plasma waves between CME- and CIR-driven storms might cause difference of the outer belt flux enhancement during the recovery phase. Future work will quantify the differences using a statistical study of both the VLF and ULF waves during CME and CIR storms.