Global distribution of ULF waves during magnetic storms on March 27, 2017 and April 4, 2017

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The relativistic electron population in the Earth's outer radiation belt is drastically variable, especially during the active condition of the magnetosphere such as magnetic storms. One of the candidate mechanisms to cause the increase or decrease of relativistic electrons is the radial diffusion of the electrons driven by ultra-low-frequency (ULF) waves in Pc5 frequency ranges. However, how much ULF Pc5 waves contribute to the evolution of the radiation belt is still an open issue. In particular, previous papers have investigated the radial distribution of ULF Pc5 waves in the inner magnetosphere, but the spatial distribution is not well understood because of the limited number of satellite.

In December 2016, the Arase satellite was launched into the inner magnetosphere, and the campaign observations between Arase and ground-based observations are now operated. During the first campaign observation from the end of March to April 2017, two distinct magnetic storms were occurred. The first storm was occurred on March 27, 2017 (Storm 1), which lasted for about six days. On the other hand, the second storm on April 4, 2017 (Storm 2) lasted for about two days. The temporal variation of the dynamic pressure and density of solar wind during each storm is almost similar. However, the solar wind flow speed data shows that Storm 1 is caused by the CIR, while Storm 2 might be caused by the CME. Therefore, background field variations that excite ULF Pc5 waves in the inner magnetosphere can be different between Storm 1 and 2. In addition, the Extremely High-Energy Electron Experiment (XEP) data onboard Arase clearly show the increase of high-energy electrons (400 keV-20 MeV) during the recovery phase of Storm 1, while they did not recover to the pre-storm level during Storm 2. Remarkable difference between two storms is the substorm activities in the recovery phase. In Storm 1, the AE index continuously increased, while in Storm 2, it stayed in low level. In this study, based on the multiple satellite observations including Arase and the global simulation by Block-Adaptive-Tree Solar -Wind Roe-Type Upwind Scheme (BATS-R-US) with the Comprehensive Ring Current Model (CRCM), we investigate the temporal and spatial distribution of ULF Pc5 waves and their relation to solar wind conditions and substorm injections.