Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM10-14 Room:A01 Time:May 28 11:30-12:00

An investigation of meteorological characteristics of ULF waves by ULTIMA global magnetometer observations

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The ultra-low-frequency (ULF) waves in the magnetosphere are phenomena resulting from the coupling between the solar wind and the magnetosphere as well as processes internal to the magnetosphere, such as magnetic storms and substorms, whose energy comes ultimately from the Sun and the solar wind. The known characteristics of ULF waves are mostly obtained through climatological studies that can be made by using observations from a handful of ground-based magnetometers. These long-term characteristics, however, can greatly deviate from the short-term variations of ULF waves. Behaving differently from one magnetic storm to another, the ULF waves are known to contribute to the acceleration, transport, and loss of electrons in the outer radiation belt.

This study examines the short-term variability of ULF waves observed by magnetometer arrays affiliated with the Ultra Large Terrestrial International Magnetometer Array (ULTIMA) consortium. The global coverage of ULTIMA arrays allows us to examine the meteorological features of storm-time ULF waves in different corners of the magnetosphere. We find that the Pc 5 power can vary by more than 5 orders of magnitude between quiet times and storm times. The Pc 5 wave power at the time of *Dst* maximum tends to peak at highest latitudes. In contrast, the Pc 5 wave power at *Dst* minimum is strongest at auroral and subauroral latitudes. Global magnetometer observations confirm that the enhancement in wave power can be highly variable in the inner magnetosphere, demonstrating the need for future geospace models to address the meteorological characteristics of ULF waves.

Keywords: ground-based magnetometers, ULTIMA, ULF waves, magnetosphere, magnetic storms