Initial Report of the Plasma Wave Experiment (PWE) onboard the ARASE (ERG) Satellite

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1. Extended Abstract

The ERG (Exploration of energization and Radiation in Geospace) project is a mission to study acceleration and loss mechanisms of relativistic electrons around the Earth [Miyoshi et al., 2012]. The ERG satellite, which was launched on December 20, 2016 and was nicknamed “ARASE”, is a satellite to explore in the heart of the Earth’s radiation belt using electric and magnetic field instruments covering a wide frequency range and electron and ion detectors over a wide energy range. Combining the data from these instruments, innovative instruments named S-WPIA (Software-Type Wave Particle Interaction Analyzer) was installed on the satellite to measure energy exchange processes between plasma waves and particles directly.

It is suggested that plasma waves such as whistler mode chorus, electromagnetic ion cyclotron wave (EMIC), and magnetosonic wave (MSW) interact with plasma over a wide energy range and consequently contribute loss process and/or acceleration process of the high-energy particles in the inner magnetosphere. In addition, DC electric field also plays an important role in controlling the global dynamics of the inner magnetosphere. The PWE (Plasma Wave Experiment) was developed to measure DC electric field and plasma waves on board the ARASE. It consists of two sets of orthogonal electric field sensors (WPT; wire-probe antennas), three-axes magnetic sensors (MSC; magnetic search coils), and receivers named EFD (electric field detector), OFA/WFC (onboard frequency analyzer and waveform capture), and HFA (high frequency analyzer). Using these sensors and receivers, the PWE covers frequency range from DC to 10 MHz for electric field, and from a few Hz to 100 kHz for magnetic field. The mission data from the PWE is categorized into two types of telemetry data; continuous data and burst data. We produce wave spectra in VLF/HF range and waveforms in ELF range as continuous data 24 hours per day. We also calculate and produce spectral matrix as continuous data using the onboard CPU. On the other hand, we intermittently produce waveform data as burst data. The burst data will be once stored on the mission data recorder (MDR) and downloaded to the ground after data selection using the continuous data. We prepare two type of burst mode; waveforms sampled at 65 kHz will be produced in “chorus burst” mode and waveforms down-sampled at 1024 Hz will be produced in “EMIC burst” mode. We also provide raw waveform data to the S-WPIA, which is expected to derive direct correlation between wave and particles.

The ARASE has passed its critical operation phase and we have confirmed successful extension of the wire-probe antennas as well as the masts. The onboard instruments including the PWE are now in the initial check out phase and we expect to obtain new scientific data soon. In the presentation, we introduce the specification of the PWE and its initial data.

References

1. Y. Miyoshi et al., The Energization and Radiation in Geospace (ERG) Project, in Dynamics of the Earth's Radiation Belts and Inner Magnetosphere, Geophys. Monogr. Ser., vol 199, edited by D. Summers, I. R. Mann, D. N. Baker, and M. Schulz, pp.103-116, AGU, Washington, D.C. doi:10.1029/2012BK001304, 2012.