

Evaluation of wave normal and Poynting vector analyses for whistler mode waves observed by the waveform capture (WFC) on board the Arase

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The Plasma Wave Experiment (PWE) is one of scientific instruments on board the Arase (ERG) satellite to measure electric field from DC to 10 MHz and magnetic field from a few Hz to 100 kHz in the inner magnetosphere. It is well known that chorus wave, one of typical plasma waves in VLF range observed in the inner magnetosphere, is a plausible candidate that accelerates relativistic electrons in the radiation belt. Besides the chorus, the Arase has observed various kinds of plasma waves such as lightning whistlers and hiss waves. It is very important to study the propagation characteristics of these waves.

In the present paper, we developed a direction finding system applicable to whistler mode waves using the data from waveform capture (WFC), which is one of receivers covering the frequency range below 20kHz implemented in the PWE. The absolute directions of the wave normal and Poynting vectors were derived in the coordinate system referring the ambient magnetic field and geomagnetic meridian plane. We also estimated the Poynting vector theoretically using the derived wave normal vector, electron density and ambient magnetic field intensity to confirm the validity of the results from the observation data.

We demonstrated that the results were generally reliable, but further calibration is necessary for electric field to improve the accuracy of Poynting vector because the waveform of electric field is now calibrated under the assumptions of theoretical antenna capacitance in a vacuum and typical plasma impedance. In other words, we expect to be able to correct the calibration table for electric field measurements from the direction finding results.

In the presentation, we introduce some typical results which have been derived from the observation data of upper- and lower-band chorus, and lightning whistlers.

Keywords: Whistler mode wave, Waveform Capture, Direction finding, Plasma wave