

Calibration of Waveform Data Measured by the Plasma Wave Experiment (PWE) on board the ARASE (ERG) Satellite

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The Plasma Wave Experiment (PWE) on board the Arase satellite measures electric field from DC to 10 MHz, and magnetic field from a few Hz to 100 kHz. The waveform capture (WFC) is one of subsystems of the PWE and is dedicated to measuring waveform for the two electric components and three magnetic field components. The WFC nominally covers the frequency range below 20 kHz, which is crucial for the measurements of chorus, hiss and magnetosonic waves. It is necessary to calibrate the WFC data in order to correctly reproduce the waveform actually measured by the sensors. In the present paper, we introduce the calibration method of the WFC data using inverse filter.

We applied the calibration tables, in which the frequency responses of sensors and receivers of the WFC are defined, provided by the Arase/PWE team. We first designed inverse filters by taking the inverse of the transfer functions of the WFC and performing the inverse FFT. In the process, we determined cutoff frequencies comparing the reproduced waveform with standard signals generated by the known signal source inside the PWE. This method is effective because waveforms can be calibrated continuously without periodical joint, although the computational complexity is large. As a future work, it is necessary to examine a method of correcting waveform distortion due to receiver nonlinearity. We also note that the electric field intensity is provisionally calibrated under the assumption of combining the theoretical antenna capacitance in a vacuum, and the typical plasma resistance. We also correct this point by comparing the refractive index obtained from both the electric field and the magnetic field waveforms with the theoretical value.

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