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Study on Omega signals detected by Poynting Flux analyzer onboard Akebono
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Suarjaya I Made Agus Dwi[1*] ; 笠原 禎也 [1] ; 後藤 由貴 [1]
SUARJAYA, I made agus dwi[1*] ; KASAHARA, Yoshiya[1] ; GOTO, Yoshitaka[1]

[1]Kanazawa University
[1]Kanazawa University

The Akebono satellite was launched 1989 to observe the Earth's magnetosphere and plasmasphere. Wave normal and Poynting flux Analyzer (PFX) subsystem is equipped on the spacecraft. It measures two components of electric field (Ex and Ey) and three components of magnetic field (B1, B2, and B3) with band-width of 50 Hz in a frequency range from 100 Hz to 12.75 kHz. The center frequency of the PFX can be changed by command. By using the PFX, we measure the signals at 10.2 kHz transmitted from the omega stations which were operated until 1997. This omega signal was intended to be used as navigation signal similar to GPS nowadays. By automatically detecting the omega signals included in the PFX data, we study propagation patterns of VLF waves across the plasmasphere, because the propagation characteristics are strongly affected by plasma density and ambient magnetic field. First we developed a method to detect the omega signals automatically and accurately, especially for the delay time and signal existence within specific earth coordinate and time span observed by the Akebono satellite. The PFX data measures 5 channels which correspond to 3 axis of magnetic field (B1, B2, B3) and 2 axis of electric field (Ex, Ey) in satellite coordinate. The waveform data with band-width of 50 Hz centered at 10.2 kHz are sampled at rate of 320 Hz and sent to the ground by PCM telemetry. As for the omega signal, the omega station was transmitting its signal with transmission pattern every 10 s. Each station transmitted a different pattern of frequency but has common frequency at 10.2 kHz. By using this 10.2 kHz signal and the detection time represented by UTC on the satellite, we can determine when and which station was transmitting the signal. As for the detection algorithm, we first estimate the delay time of each signal by comparing average intensity of specific time frame then expecting sudden increase of intensity based on specific threshold on the expected omega signal's time and duration. Second, we detect the signal existence by comparing the intensity of expected omega signal's time and duration with the surrounding intensity based on specific threshold. In this study we used advanced detection algorithm to process huge amounts of several years' data. The algorithm enables us to distinguish noises and real omega signal and also handle the error detection to produce more accurate result. Currently we have analyzed data sets from 1989 to 1990. We found that the magnetic field intensity of the signal become weaker and the electric field intensity become higher on the other part of earth hemisphere far from the original transmission station. We will analyze further data sets from 1991 to 1997 for more credible analysis and discovery.

キーワード: VLF 波動, Omega 信号, プラズマ圏, あけぼの衛星, 信号処理
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