Propagation Characteristics of Omega Signals with Regard to Plasma Density and Ambient Magnetic Field

Suarjaya I Made Agus Dwi[1]; Yoshiya Kasahara[1]; Yoshitaka Goto[1]
[1] Kanazawa Univ.

Poynting Flux Analyzer (PFX) subsystem on board the Akebono satellite had been received signals at 10.2 kHz from Omega system since 1989 to 1997. Omega was a navigation system which transmitted its signals based on pattern every 10 seconds. Because the global plasmaspheric electron density changes day by day, it is important to see the trend of this change by using statistical study of electromagnetic wave propagation for several years. Observing signal from artificial transmitters is worth analyzing for such purpose because these signals were transmitted with constant power all the time, thus we can analyze how much change happened to the propagation depending on local time, season and solar activity. To analyze these data, we developed a method for automatic detection of Omega signals from the PFX data in a systematic way, it involves identifying a transmission station, calculating the delay time, and estimating the signal intensity.

Based on the PFX data from October 1989 to September 1997, our analysis on high-middle latitude of omega station revealed that signals transmitted from two stations located at Norway and North Dakota, whose geomagnetic latitude are almost the same at 55.9 N, propagated along the Earth's magnetic field through different L-shell. We believe this was caused by different latitude in geographic coordinate, where the Norway station was located at 56.42 N and the North Dakota station was located at 46.37 N. Thus, the different sunlit condition affected the plasmaspheric electron density, that is, the night duration is expected to be longer at the Norway station than the North Dakota station. This finding also clarified by our seasonal analysis, by looking at the shifted high intensity region especially in the electric field because of change in day and night duration between equinox and solstice. We found that the omega signal tends to propagate farther in the night side where the plasmaspheric electron density lower than in day side. Lower intensity level especially near the equator in day side suggested denser plasmaspheric electron density in that region. We also found that solar activity effects the omega signal propagation. In 1991 when the solar activity was maximum, the omega signal propagated lower in intensity level and in 1996 when the solar activity was minimum, the omega signal propagated higher in intensity level and farther from the transmitter station. Both of the seasonal and yearly analyses confirmed that plasmaspheric electron temperatures also affected the propagation of Omega Signal.