Lomb-Scargle periodogram analysis of Pc5 waves observed by the SuperDARN Hokkaido East Radar and ground-based magnetometers

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Ultralow frequency (ULF) waves in the Pc5 frequency range (~1.7-6.7 mHz) observed in geospace are considered to be magnetohydrodynamic (MHD) waves mainly excited in the magnetosphere. They propagate along the earth's magnetic field lines and reach the ionosphere, causing perturbation of the ionospheric plasma motion and the magnetic field. ULF waves observed by the Super Dual Auroral Radar Network (SuperDARN) can be categorized into toroidal and poloidal modes with respect to their polarization. We analyzed Pc5 oscillation modes in ULF waves using the SuperDARN Hokkaido East high-frequency (HF) radar data. We applied the Lomb-Scargle periodogram method to the Doppler shifts of ionospheric irregularities obtained by the radar. First, we automatically identified Pc5 waves with normalized peak powers larger than the significance level of 99 % considering the false alarm probability based on white Gaussian noise. Next, we compared the eigenfrequency, amplitude and phase of Doppler velocity oscillations in the Pc5 range among different beams at a fixed MLAT. The results were that the eigenfrequency, amplitude and phase were clearly correlated with the beam number, i.e., magnetic longitude. The eigenfrequency result was interpreted from the MLT dependence of the length of the magnetic field line. We identify the modes from the amplitude result and the longitude propagation direction from the phase result. Furthermore, the time-series data of Pc5 Doppler velocities obtained from the radar showed a high correlation with ground-based magnetic field data at Moshiri (Japan). We will discuss the details of this relation from the viewpoint of field-aligned currents.