Mode and m-number analysis of ULF waves in the Pc5 frequency range observed by the SuperDARN Hokkaido East radar

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Ultralow frequency (ULF) waves driven in the magnetosphere propagate along the magnetic field lines to the ionosphere and cause the perturbation of the ionospheric plasma, which can be observed by the Super Dual Auroral Radar Network (SuperDARN). The ULF waves observed in the ionosphere with the SuperDARN radars contain poloidal and toroidal modes. We analyzed the modes and m-number of ULF waves in the Pc5 frequency range (1.7-6.7 mHz) with multiple line-of-sight ionospheric plasma velocity data obtained by the SuperDARN Hokkaido East radar. First, we simulated the amplitude and phase of the Doppler velocity at each beam using the modeled Pc5 waves with various parameters such as the poloidal/toroidal wave amplitude ratio and m-number. Then, based on the model calculation results, we estimated the mode and m-number of the Pc5 waves actually observed by the radar. Finally, we conducted statistical analysis to reveal the magnetic latitude (MLAT) and magnetic local time (MLT) dependence of the dominant mode and m-number. The occurrence rate of toroidal mode Pc5 waves is higher than that of poloidal mode during 21-23 MLT and during 0-3 MLT in the range of 42-50˚ MLAT, in agreement with the statistical MLT results of Liu et al. (2009). To the best of our knowledge, it is the first study on the MLAT and MLT dependences of the Pc5 wave modes in the midlatitude region with SuperDARN. The m-number characteristics are also discussed.

Keywords: ULF, Pc5, poloidal, toroidal, mode, SuperDARN

