

Estimation of spatial structure of sporadic E layer with 2-dimensional FDTD simulations

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We developed a 2-dimensional FDTD simulation code which can treat wave propagations in magnetized plasma. FDTD simulations can be performed with much less computer resources than those necessary for full particle simulations, in memories as well as cpu times. In this study, we performed FDTD simulations with different types of electron density profiles in the lower ionosphere, uniform ionospheric layer model and oval shape electron cloud model, and then confirmed characteristics of MF wave propagations in the lower ionosphere. We especially study on effects of wave frequencies. According to sounding rocket experiments, we can only obtain altitude profile of wave intensity, especially magnetic field intensity. In this study, therefore, we are going to try to estimate spatial structure in the lower ionosphere by analyzing altitude profile of magnetic field intensities of waves with various frequencies.

Simulation results indicate that spatial structure in the lower ionosphere can be estimated by analyzing altitude profiles of different waves emitted from different wave sources with various frequencies. Effects of spatial structure in the lower ionosphere are shown especially on propagation characteristics of MF waves above the altitude of the spatial structure itself. For the future, we are going to perform simulations with more different models, for example, Es model of wave structure. And, we made comparison between the results of conducted rocket experiments in 2011 and the simulation results, verified whether we can estimate the spatial structure of Sporadic E layer.

Keywords: Sporadic E layer, FDTD simulation, ionosphere, electron density profile, plasma wave propagation