

Analysis of Propagation Characteristics of Radio Wave by S-520-29 Sounding Rocket

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S-520-29 sounding rocket experiments was carried out in Uchinoura Space Center on August 17, 2014. The purpose of this sounding rocket experiments is observation of sporadic E layer that appears in the lower ionosphere at near 100km. Therefore, the experiments was carried out using three methods. The first method is an optical method that observe light of metal ion emitted by the resonance scattering in sporadic E layer using the imager. The second is a method of using radio waves that receive the LF/MF band radio waves transmitted from the ground to rocket. The third is a method that measuring the electron density in the vicinity of sounding rocket using the fast Langmuir probe and the impedance probe. In this presentation, we explain the preliminary report of radio waves observations and radio waves propagation characteristics using frequency analysis of S-520-29 sounding rocket experiment. This rocket was equipped with LF/MF band radio receiver for observation of characteristics of LF/MF band radio waves propagation, and observe the LF/MF band radio waves in rocket flight. Antenna of LF/MF band radio receiver is composed of three axis loop antenna. LF/MF band radio receiver receives three radio waves of 873kHz (JOGB), 666kHz (JOBK), 60kHz (JJY) from the ground. 873kHz and 60kHz radio waves are coming from north side of the rocket, 666kHz radio waves are coming from the east side to the trajectory of the rocket. It is possible to estimates the position and size of the high electron density region in the sporadic E layer by analysis radio waves propagation characteristics using radio waves come from different directions. In the sounding rocket experiment, LMR was working properly. We have completed the observation of radio wave intensity. We analyze the observation results using a Doppler shift calculations by frequency analysis. Radio waves received by the sounding rocket undergoes a Doppler shift by polarization and direction of rocket spin and magnetic field of the earth. Radio waves received by the sounding rocket was separated into characteristics waves using frequency analysis. Then we calculate the Doppler shift from the separated data. Finally, this study estimate the electron density by using Doppler shift and the equation of Booker. As a result, 873kHz, 666kHz radio waves are reflected by the ionosphere. 60kHz radio wave was propagated to maximum altitude of sounding rocket after it converted into whistler mode. Then, this study was able to estimate the altitude distribution of electron density by using the Doppler shift. In this study, we explain the reports of LMR observations and characteristics of radio waves propagation by frequency analysis by S-520-29 sounding rocket experiment.

Keywords: sounding rocket, radio wave propagations, Doppler shift, sporadic E layer