

Analysis of natural electric field and plasma density associated medium-scale traveling ionospheric disturbance (MSTID) from the sounding-rocket S-520-27 experiment

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Medium-scale traveling ionospheric disturbance (MSTID) is an interesting phenomenon in the F-region. The MSTID is frequent in summer nighttime over Japan, showing wave structures with wavelengths of 100-200 km, periodicity of about 1 hour, and propagation toward the southwest. Although one hypothesis for the generation mechanism of MSTID is suggested by computer simulation, its confirmation by observation is necessary. We had a chance of launching the sounding rockets S-520-27 and S-310-42 to the MSTID region on July 20, 2013 from JAXA Uchinoura Space Center. This study aims to provide accurate data of natural electric field and plasma density from the sounding rocket S-520-27 experiment. Natural electric field was measured by the double-probe sensor on the rocket. The data were analyzed with location and attitude of the rocket and the geomagnetic field model. Accuracy of the analysis is improved as we use the revised rocket attitude that is more accurate than before. Also we propose an estimation method of electric field, which makes use of the orthogonality of the electric field to the geomagnetic field. Obtained natural electric field associated with MSTID was about 5 mV/m. Plasma density from this experiment, on the other hand, was measured by the rocket-ground dual-band beacon experiment. First, total electron content (TEC) was derived from signal processing of the dual-band beacon. Secondly, distribution of plasma density was estimated by tomographic technique. We set the initial data by referring to the data from the impedance probe on the rocket and the three-dimensional GPS-TEC tomography based GEONET. As a result, disordered structure of plasma density with wavelength of 100 km was found. By comparison of these natural electric field and plasma density data, anti-correlation between the two elements was found. In the area of depleted plasma density, the electric field was northeastward, and its intensity became maximum. Above all, this study successfully derived natural electric field and plasma density data which are reasonable for ionosphere behavior and have potentiality for understanding electromagnetic interrelationship between E and F region.

Keywords: Sounding rocket experiment, Electric field, Plasma density distribution, Medium-scale traveling ionospheric disturbance