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DC Electric Field Measurement during MSTID Occurrence by S-520-32 Sounding Rocket

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The Medium Scale Traveling Ionospheric Disturbance (MSTID) is a plasma density structure which occurs in the middle latitude ionospheric F region in summer night. The S-520-32 sounding rocket was launched at 23:20 JST on 11 August, 2022 from JAXA Uchinoura Space Center in order to elucidate the MSTID generation mechanism. This sounding rocket observed between ionosphere E region and F region during the MSTID occurrence.

The Electric Field Detector (EFD) on board the S-520-32 sounding rocket observed the DC electric field in the spin plane of the payload using double probe method [1] and AC electric field. The AC electric field is ultra-low frequency less than 3.2 kHz. The EFD has two set of orthogonal double probes, which are tip to tip 5.5 m. These probes were all extended and the EFD observed successfully. The result of DC electric field is sinewave because the EFD observe the sum of the natural electric field and the induced electric field when the rocket crosses the Earth's magnetic field as the DC electric field. The natural electric field can be derived by subtract the induced electric field from the observed electric field. In addition, the DC electric field vector was derived from the natural electric field using rocket attitude. By the FFT analysis of the AC electric field, the characteristic waves occur from 0 Hz to 50 Hz and from 500 Hz to 1500 Hz at altitude above 120 km.

In this paper, we will show the analysis result of the DC electric field vector and AC electric field. The polarized electric field is considered to generate in tune with the plasma density structure. The DC electric field vector would be same as the polarized electric field and show the plasma flow during MSTID. Furthermore, the plasma density instability would cause plasma wave. We will investigate whether the observed AC electric field is the plasma wave by comparing the observed AC electric field and the observations of the other instruments.

References

[1] Gurnett, D. A., "Principles of Space Plasma Wave Instrument Design," In R. F. Pfaff, J. E. Borovsky, D. T. Young (Eds.) *Measurement Techniques in Space Plasmas Field, Geophysical Monograph Series* (Vol. 103, pp.121-136). Washington, DC: American Geophysical Union