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DC electric field measurement in the mid-latitude ionosphere by S-520-26 sounding rocket

Atsuhi Yamamoto [(1)], Keigo Ishisaka* [(1)], Makoto Tanaka [(2)], Mamoru Yamamoto [(3)], and Takumi Abe [(4)]

(1) Toyama Prefectural University, Japan
(2) Tokai University, Japan
(3) RISH, Kyoto University, Japan
(4) ISAS/JAXA, Japan

S-520-26 sounding rocket experiment was launched at Uchinoura Space Center (USC) in Japan at 5:51 JST on 12 January,2012. The purpose of this experiment is the investigation of the bonding process between the atmospheres and the plasma in the thermosphere. The S-520-26 payload was equipped with Electric Field Detector (EFD) with two set of orthogonal double probes. ITA (inflatable tube antenna) and RA (ribbon antenna) were equipped in order to measure the electric field. The antenna length of ITA is 5.0 meters, and the antenna length of RA is 2.4 meters. The tips of each boom were attached the electrodes to the probe, and it performed observe the electric field by measuring the electric potential difference between the probes. Observation data was amplified by the preamplifier, and it was transmitted to the ground station from the main electronics unit. The EFD observed the electric field from DC to 200 Hz.

The rocket passes through the magnetic field, so it observes the induced electric field (v x B). Therefore, the observed electric field includes the DC electric field and the v x B electric field, so it is necessary to subtract the v x B electric field. Accordingly, the v x B electric field was calculated using the rocket velocity data, the magnetic field data, and the rocket attitude data. Then, we derived the DC electric field in the ionosphere.

We analyzed the electric field data during from 180 seconds to 380 seconds (altitude about 254 to 297 km) after the rocket launched. The DC electric field could not be observed due to lithium emission at the time of rocket descent. There was the difference of the 1/4 wavelength in the wave form of two electric field strength observed from ITA and RA. This result indicates that the two antennas are extended orthogonally. In addition, we confirmed the direction of the v x B electric field. Then, we understood that the direction of the v x B electric field changed from north-northwest to the east-northeast while it inclined on diagonally upward. Moreover, we understood that the magnitude of the v x B electric field grew large as change into the east-northeast direction. Then, we converted the v x B electric field from the geographical coordinate system to the spin coordinate system using the spin component, and subtracted the v x B electric field of the spin coordinate system from the observation data. Furthermore, we removed the spin component from the subtracted data, and we removed pulse noise by photoemission using the moving average.

As a result of calculating, we derived DC electric field. The intensity of the DC electric field was about 0 to 6.4 mV/m. Specifically, the direction of the DC electric field vector was about the west direction and the intensity of the DC electric field is about 0 to 2.0 mV/m at an altitude of about 254 to 266 km (rising), about the east direction and about 0.6 to 1.3 mV/m at an altitude of about 267 to 289 km (rising), about the west direction and about 1.2 to 4.9 mV/m at an altitude of about 290 to 297km (rising) and 297km to 295km(descending), about the southeast direction and 1.6 to 6.4 at an altitude of about 294 to 254 km (rising). The intensity of the DC electric field was about 0.2 to 6.0 mV/m.

In the future, we will compare the analyzed data with the data of other observation instruments, and we will investigate the plasma dynamics in the ionosphere.