

S-310-44号機によるSq電流系付近のDC/AC電場観測

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DC and AC Electric Field Measurements near the Sq Current System by S-310-44 Sounding Rocket

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The Sq current system occurs in the lower ionosphere in the winter daytime. The Sq current system is appeared the specific plasma phenomenon such as electron heating, strong electron density disturbance. S-310-37 sounding rocket had been performed in the past, however it was not possible to observe the electric field component. It is one of the reasons that the photo electron caused by the sunlight that is irradiated to the rocket body, and affect the electric field observations. It is very difficult to remove the influence of the photo electron from the observed data. If it is possible to put the electrode of the electric field sensor outside of the region where there becomes the photo electron around the rocket body, the influence of the photo electron can be reduced. Therefore, the antennas need a length as long as possible to observe the electric field. Accordingly, the antennas of S-310-44 sounding rocket is 4m tip-to-tip that is twice as length than the antennas of S-310-37 sounding rocket. The purpose is to reduce the influence of the photo electron moreover to measure the electric field more accuracy.

It was carried out S-310-44 sounding rocket experiment at 12:00 LT on January 15, 2016. This rocket passed through the Sq current focus. In addition, scientific instruments that are equipped on the rocket also operated normally. The electric field detector was able to observe the DC electric field up to 100Hz and the waveform of AC electric field up to 6400Hz in the altitude from 100km to 160km. There was not seen the effect by photo electron in the DC electric field data. The observed DC electric field is included in the induced electric field ($v \times B$ electric field) in addition to the natural electric field. The $v \times B$ electric field is caused by the rocket to pass through the magnetic field. It is necessary to remove the $v \times B$ electric field from the observed data in order to determine the electric field vector near the Sq current system. The $v \times B$ electric field is calculated by using the attitude of the rocket and the magnetic field data from the IGRF. The DC electric field reached a maximum 15 mV/m at altitude 110 km and then decreased as the altitude increases. The spectrum of AC electric field in the frequency range from 2 kHz to 3 kHz look to enhance at the altitude of about 100 km. This electric field component observe during the rocket ascent only. Therefore, it is possible that the electric field component is the plasma wave related to the Sq current system. It was found that the electron temperature at the altitude from 100 km to 110 km was about 150 K larger than the background by using the fast Langmuir probe measurement. This suggests an existence of electron heating region in the Sq current focus. Therefore we guess the large DC electric field and the spectrum of the VLF band electric field are related for the Sq current system.

We will derive the vector of the DC electric field and VLF plasma waves, and then investigate whether the large electric field is affecting the electron heating region in the Sq current focus.