冬季電離圏Sq電流系中心付近で観測された狭帯域プラズマ波動の生成メカニズム

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Generation mechanism of the narrowband plasma waves found around Sq current focus in the winter ionosphere

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Generation mechanism of the narrowband plasma waves in a frequency range of several kHz observed in the sounding rocket experiment S-310-44 was investigated based on the lower hybrid drift instability model. S-310-44 was launched at 3:00 UT (12:00 JST) on January 15, 2016 at Uchinoura Space Center (USC) in order to clarify electron heating phenomena in the center of Sq current focus in the winter ionosphere. Plasma Wave Monitor (PWM) onboard the S-310-44 successfully measured plasma waves in a frequency range from 300 Hz to 22 MHz along the rocket trajectory with apex altitude of 160 km, which is also confirmed to be near the Sq current focus by using data from magnetometer chain on the ground. The AC electric field was picked up with two antenna elements (EFD-ANT-1 and 2), and respectively amplified by two preamplifiers (EFD-Pre-1 and 2) of the Electric Field Detector (EFD). Then, two signals were fed to two PWM inputs (PWM-HF and PWM-VLF), respectively. The signal fed to PWM-HF was sampled at 81.92 MSPS and converted to spectrum in a frequency range from 20 kHz to 22 MHz with 400 frequency steps. The signal to PWM-VLF was sampled at 81.92 kSPS and converted to spectrum in a frequency range from 300 Hz to 20kHz with 400 frequency steps. These spectra were obtained every 125 msec. EFD antenna elements were stored on the ground and deployed at altitude of 85 km. So the altitude range from 85 km to 160 km are covered in ascent, and all altitude range below 160 km are covered in descent. During the flight, we found harmonic emissions in a frequency range from several hundred Hz to several kHz. The frequency of the fundamental emission varies from 0.5 kHz to 2.5 kHz depending likely on the ambient plasma density. They are enhanced at altitude around 100 km in ascent but not enhanced at the same altitude in descent. In ionospheric F region, some previous studies suggested that the lower hybrid drift instability (LHDI) can occur and cause the plasma irregularities during equatorial spread F [Huba et al., 1981]. We applied LHDI model to altitude range below 160 km and found that instability can not occur in a frequency range below 2 kHz due to high electron collision frequency in ionospheric E region. The enhancement of plasma waves at altitude around 100 km in ascent even with high electron collision frequency suggests that some additional free energy source should exist in this narrow area. Through the comparisons with data from the other instruments onboard the S-310-44 such as electron density and temperature (FLP), DC and AC electric fields (EFD), and currents (MGF), we are going to discuss the energy source of the observed plasma waves in more detail.