Lower hybrid resonance (LHR) waves around the Sq current focus in the winter lower ionosphere

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The plasma waves around lower hybrid resonance (LHR) frequency around Sq current focus in the winter lower ionosphere was investigated based on the data obtained by sounding rocket S-310-44. In order to clarify electron heating phenomena in the center of Sq current focus in the winter ionosphere, the sounding rocket experiment S-310-44 was launched at 21:00 UT on January 15, 2016 at Uchinoura Space Center (USC). Plasma Wave Monitor (PWM) onboard the S-310-44 was 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. During the flight, harmonic emissions of LHR were found in a frequency range from several hundred Hz to several kHz. Their frequencies changes depending on the ambient plasma density and likely on the ion compositions. They are enhanced at altitude around 100 km in ascent but not enhanced at the same altitude in descent.

The LHR waves in the ionosphere can be generated by various energy inputs. Baker et al. [2000] reported that LHR emissions were found in the sounding rocket experiment, and suggested that they are caused by the whistler waves from the thunderstorms on the ground. At S-310-44 launch, however, the nearest weather front was farer than 1000 km distance, and clear inducing impulsive emissions of lightning were not found with LHR emissions. Cattel and Hudson [1983] suggested that perpendicularly heated ions, which were found in cusp and auroral regions, can cause flute mode waves near LHR frequency. Several studies suggested that lower hybrid drift instability (LHDI) can be caused in the inhomogeneous plasma in the ionosphere [Huba and Ossakow, 1981] and thin cross field current sheet in the magnetosphere [Yoon et al., 2008]. So, we can consider several candidates for causing LHR waves found in S-310-44 experiment: (a) Localized cross field current around the Sq current focus, (b) ions heated by the interhemispheric field aligned current (IHFAC) around Sq current focus, and (c) inhomogeneous plasma in the ionosphere. In the presentation, we will also verify the candidates using other data such as electron number density and temperature (FLP), DC and AC electric field (EFD), and magnetic field (MGF) onboard S-310-44.