R005-33
Zoom meeting C ：11/2 AM2 (10:45-12:30)
11:00〜11:15

D-region ionospheric effects of fireballs occurred in Hokkaido using VLF/LF transmitter signals

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Meteors and fireballs are known to ionize the D-region and lower E-region ionospheres at 80-120 km heights [Davies, 1966]. The fireballs are meteors whose magnitude of brightness is larger than -4 based on the IAU (International Astronomy Union) definition. TID (traveling ionospheric disturbance) associated with the Chelyabinsk meteoroid in Russia was reported based on GPS-TEC (total electron content) observations [Perevalova et al., 2015]. The amplitude and averaged period of the TEC variations were 0.07-0.5 TECU (1TECU=10^{16} electrons/m^2), and 10 minutes, respectively. The epicenter of the TID was airburst point at 20-30 km heights of the meteoroid, and the TID velocities were 250-660 m/s. As for D-region variations associated with meteoroids/meteors/fireballs, periodic variations in the phase of the transmitter signal (the frequency of RBU transmitter:66.67 kHz, Moscow, Russia) were observed after the Chelyabinsk meteoroid [Chernogor, 2015]. However, few quantitative studies for the D-region ionosphere associated with meteors and fireballs have been reported. In this study, we investigate the variations in the D-region ionosphere during a fireball occurred in Hokkaido at 11:55:55 UT on 18 October 2018, using VLF (very low frequency, 3-30 kHz) / LF (low frequency, 30-300 kHz) transmitter signals. The transmitter signals are reflected in the D-region ionosphere and intensities of the received signals are sensitive for variations in electron density in the lower ionosphere. The transmitters used in this study were JJY40kHz (Fukushima, Japan, 37.37 N, 140.85 E), JJY60kHz (Saga, Japan, 33.47 N, 130.18 E), and JJI (Miyazaki, Japan, 22.2 kHz, 32.05 N, 130.82 E). The receiver was located at RKB (Rikubetsu, Hokkaido, Japan, 43.45 N, 143.77 E). Periodic variations of 100-200 s were identified by a wavelet transformation of the signal intensities for the JJY40kHz-RKB, JJY60kHz-RKB, and JJI-RKB paths at about five minutes (12:01 UT) after the fireball. We consider that these variations of intensity were caused by the D-region variations due to acoustic waves in the atmosphere excited by the fireball. If the acoustic waves were excited at the beginning point (118 km altitude) or end point (25 km altitude) of the fireball, the propagation times of the acoustic waves from the exited point to the LF reflection point at 90 km height over RKB were calculated to be 138 s or 311 s, respectively. The arrival time (311 s) of the acoustic waves excited from the end point at the 25 km altitude agreed with the time lag between the fireball and onset of the VLF/LF variations with the period of 100-200 s. From the onset of the VLF/LF variations, we estimated the location where the variations in the D-region initiated along the paths. The estimated location was close to the RKB. The VLF/LF variations would be caused by acoustic waves excited at the end point. The acoustic waves obliquely propagated from the end point (25 km altitude) up to the D-region height (90 km altitude) at the south point of the RKB receiver.